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Functional Anatomy of the Temporomandibular Articulation*

Harry Sicher, M.D.

The temporomandibular or mandibular articulation, the articulation between mandible and cranium, is, in many ways, a highly specialized joint and is distinguished from most other articulations by the fact that the articulating surfaces of the bones are not covered by hyaline cartilage but by an avascular fibrous tissue which may contain a variable number of cartilage cells and, then, can be designated as fibrocartilage. It is further characterized by the fact that the two articulating complexes of bone carry the teeth, whose shape and position gain a deciding influence upon the movement of the joint. A restricting influence on the movements of the mandible is finally exerted by its bilateral articulation with the cranium, so that the right and left temporomandibular articulations are necessarily coupled.

The temporomandibular joint is a complex joint because an articular disc is interposed between temporal bone and mandible, dividing the articular space into an upper and lower compartment. In the upper compartment gliding movements occur, while the lower compartment functions as a true hinge joint. The temporomandibular joint can therefore be classified as a *hinge joint with movable socket.*

The articular surface of the mandible is the upper and anterior surface of the mandibular head or capitulum that forms the *semicylindroid* extremity of the condyloid process. The condyle is strongly convex in an anteroposterior direction and slightly convex mediolaterally. The latter convexity is often replaced by a more or less tent-like formation of the upper surface of the condyle which is divided into a medial and a lateral slope by a variably prominent sagittal crest. Other variations in the shape of the condyle are very frequent. Sometimes the facet of the capitulum is partly divided into a medial and a lateral part by a shallow, rough groove. Most of the irregularities of the bony surface, however, are obscured and smoothed by the thick covering of fibrous tissue.

The articulating surface of the temporal bone is situated anteriorly to the tympanic bone on the squamous temporal and comprises the concave articular fossa and the convex articular eminence or tubercle.

The fissure that separates the articular fossa from the tympanic bone is, incorrectly, described as the petrotympanic fissure or Glaserian fissure. In reality it is, in its lateral part, a tympanosquamosal fissure while more medially a bony plate intervenes between squama and tympanic bone, protruding between the two as the tip of the tongue protrudes between the lips, thus dividing the fissure into an anterior petrosquamosal and a posterior petrotympanic fissure.

The posterior border of the articular fossa is elevated to a ridge, the posterior articular lip. In most individuals the posterior articular lip is higher and thicker at its lateral end and thus is seen in profile as a cone-shaped process between the articular fossa and tympanic bone (Fig. 1).

Therefore, a displacement of the condyle backward and upward is always directed against the posterior articular lip and not against the tympanic bone. Even though the posterior lip is limited to the lateral half of the articular fossa it must be clear that it prevents a direct influence of the condyle on the tympanic bone. Some authors seem to

*Read at the 12th Australian Dental Congress, Sydney, August, 1950.

forget the self-evident fact that a condyle can move only as a unit and *only* in unison with the other condyle.

Medially, the articular fossa narrows considerably and is bounded by a bony lip which leans against the angular spine of the sphenoid bone. Only the fracture of the internal lip or its destruction could permit a medial displacement of the condyle. The presence of the medial articular lip also prevents a lateral displacement of the condyle, since this could occur only under simultaneous medial displacement of the other condyle.

Anteriorly, the articular surface continues on to the articular eminence, strongly convex in an anteroposterior direction and somewhat concave in a mediolateral direction. The degree of its convexity is highly variable, the radius of the curvature varying from 5 to 15 millimetres.

The articular disc is an oval fibrous plate of great firmness. Its central part is always considerably thinner than its periphery; the posterior border is especially thick. The posterior part of the disc varies in thickness and its variations seem to be correlated to the degree of prominence of the articular eminence: the more prominent the articular tubercle, the thicker the posterior border of the disc. Posteriorly the disc continues into a thick layer of loose and vascularized connective tissue which connects the disc with the posterior wall of the articular capsule (Fig. 2).

Fig. 1.—A skull with well developed postglenoid process.

The fibrous layers covering both mandibular and temporal surfaces are avascular. Blood vessels are also absent in the firm central area of the articular disc. The lack of blood vessels is proof of the fact that there is considerable pressure in this joint. Avascular connective tissue is well adapted to resist pressure, though it is not as highly specialised as cartilage. The differentiation of islands of cartilage in the fibrous layers and, more rarely, in the disc occurs as a rule only in higher age periods and can be regarded as a response of the tissue to pressure and friction.

Fig. 2.—Microphotograph of a section through the temporomandibular articulation of a young adult. Note the position of disc and condyle to the eminence. Behind the firm disc a darker coloured mass of loose connective tissue extends to the posterior capsule.

Also the direction of the fibre bundles in the fibrous covering of the articulating bones is characteristic and evidences the pressure-bearing adaptation of this joint. The fibres run at right angles to the bony surface in the deep layer, parallel to the surface in the superficial layer. In this arrangement, the fibres duplicate the directions of the fibrils in an articular cartilage. The deeper layers are adapted to pressure, the superficial layers to sliding under pressure.

The synovial capsule of the temporomandibular joint is attached to the rim of the temporal articular surface. It fuses with the disc around its entire circumference, covering the loose connective tissue behind the disc, and continues, below the disc, to the mandibular head. There, as is the rule for convex articular bodies, the synovial capsule inserts at some distance from the articulating surface itself and reflects upon, and covers, the neck of the mandible to the borderline of the articulating facet. The synovial capsule forms small folds and villi, especially in the region behind the firm part of the disc.

The articulating surfaces of temporal bone and mandible and the surfaces of the disc are, of course, free of synovial membrane. It

must be emphasized that a synovial membrane is characterized by its rich supply of blood vessels, a prerequisite for the function of a synovial membrane, namely, to elaborate the lubricating and nutritional synovial fluid. The avascular tissues covering the articulating bodies and the disc derive their nutritional elements almost entirely from the synovial fluid. The intact synovial layer is therefore of vital importance for the articulation.

The fibrous capsule of the mandibular joint follows closely the synovial capsule and is rather thin. Only laterally the fibrous capsule is strengthened to a fairly distinct ligament, the temporomandibular ligament. The capsule between the temporal bone and disc is loose to allow the extensive sliding movement in the upper compartment of the articulation. Between the disc and the mandibular condyle, however, the capsule is much tighter. Here, where only hinge movements occur, the capsule is especially tense between the disc and the two poles of the condyle. The disc appears therefore bound to the condyle by short fibres functioning as collateral ligaments.

Two ligaments have been described as accessory ligaments of the temporomandibular articulation namely, the sphenomandibular and the stylomandibular ligament. Neither one has any functional relation to the mandibular articulation, still less a decisive influence upon the movement of the mandible.

Four powerful muscles, the masseter, the temporal, the internal pterygoid and the external pterygoid, are designated as the muscles of mastication. Three of these, the masseter, temporal, and internal pterygoid, exert their power mainly in a vertical direction, acting as closing muscles of the jaws. The fourth, the external pterygoid, is situated in a horizontal plane and acts as a protractor of the mandible. All of these muscles are supplied by branches of the third division of the trigeminal nerve. These muscles, in conjunction with the suprahyoid musculature, work in groups as do muscles in all parts of the body and not as individual units.

The *masseter muscle*, the most superficial of the masticatory muscles, stretches as a rectangular plate from the zygomatic arch to the outer surface of the mandibular ramus. The muscle can be divided, though incompletely, into a superficial and a deep portion. The superficial portion arises from the lower border of the zygomatic bone with strong tendinous fibres. The fibres of the superficial portion have a general direction downward and backward to insert in the angular region of the mandible. The attachment occupies the lower one-third or one-fourth of the posterior border of the ramus, the lower border anteriorly to the level of the second molar, and the outer surface of the ramus in its lower half (Fig. 3). The field of insertion shows ridges to which the tendons, and grooves between the ridges to which the fleshy fibres insert.

Fig. 3.—The superficial and the deep portion of the masseter and the temporomandibular ligament.

The superficial plate of the masseter is covered, on its outer surface, by a strong tendinous layer which extends from the zygomatic bone over one-half of two-thirds of the muscle. The tendon ends with a downward convex border or in a zigzag line. If the overlying tissues are not too thick, the border of the tendon can be seen in the living because of the contrast of the flat tendon to the strongly bulging muscle fibres below the tendon. In the depth, the superficial portion is formed by alternate tendinous and fleshy bundles so that the intimate structure of the muscle is rather intricate. The effect of the alternation of muscle fibres and layers of tendon is to enlarge the number of muscle fibres and the functional cross section of the muscle. The functional cross section of the muscle may be defined as the sum total of the cross sections of its muscle fibres; it determines the power of a muscle. Muscles composed of long parallel muscle fibres, arranged in the long axis of the muscle, will primarily act as fast movers. Muscles composed of fibres arranged at an angle to the long axis of the muscles will consist of relatively more and shorter fibres and will, therefore, primarily be muscles of great power.

The intimate structure of the masseter muscle proves that it belongs to the second category.

The deep portion of the masseter can be separated from the superficial portion only in the posterior part of the muscle. Anteriorly, the two layers fuse. The fibres of the deep portion arise from the entire length of the zygomatic arch, in front of the articular eminence, and run almost exactly downward and thus are at an angle to the fibres of the

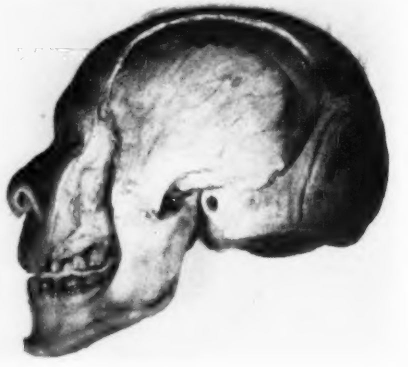

Fig. 4.—The temporal muscle was exposed by removal of zygomatic arch and masseter. The horizontal fibres of the temporal bend around the root of the zygomatic arch into an oblique forward direction.

superficial muscle plate which are directed downward and backward. The deep part of the masseter muscle is inseparably fused with the most superficial fibres of the temporal muscle.

The action of the masseter is that of a powerful elevator of the lower jaw closing the jaws and exerting pressure upon the teeth, especially in the molar region. The superficial portion exerts pressure at a right angle to the posteriorly ascending occlusal plane of the molars (curve of Spee). The fibres of the deep portion are directed downward and forward if the mandible is in protruded positions. The deep portion has therefore a retracting component which is important during the closing movement, a combination of elevation and retrusion.

The fan-shaped *temporal muscle* has its origin in a wide field on the lateral surface of the skull which is surrounded by the inferior temporal line. On the greater wing of the sphenoid bone the field of origin reaches downward to, and includes, the infratemporal crest. In addition, many muscle fibres originate from an aponeurosis fused to the inner surface of the temporal fascia, especially in its upper part.

The bundles of the temporal muscle converge toward the opening between the zygomatic arch and the lateral surface of the skull, in the centre of which the apex of the coronoid process is situated. The anterior fibres which form the bulk of the muscle are vertical; the fibres in the middle part of the muscle are increasingly oblique. The most posterior fibres run almost horizontally forward but bend in front of the articular eminence downward and forward to reach the mandible (Fig. 4). As in the masseter muscle, the flesh of the temporal muscle is divided by deep tendinous plates. The muscle fibres are, therefore, actually much shorter than most illustrations indicate but are longer than those of the masseter muscle.

The insertion of the muscle occupies the coronoid process and reaches down to the ramus of the mandible. Deep fibres of the muscle send two tendons far down toward the posterior end of the alveolar process (Fig. 5).

The temporal muscle, built for movement rather than for power, is mainly an elevator of the mandible. Its most posterior fibres have a retracting component because of their oblique direction downward and forward below the zygomatic process.

The temporal fascia is set in a frame formed by the temporal line and the upper border of the zygomatic arch. The temporal fascia is not directly comparable to a muscle sheath; it

Fig. 5.—The two tendinous slips of the temporal muscle are seen. The outer or superficial tendon is attached to the anterior border of the coronoid process and mandibular ramus; the inner or deep tendon is inserted to the temporal crest of the mandible.

is rather the suspensory bracing of the thin zygomatic arch against the downward pull of the masseter muscle.

The *internal pterygoid muscle*, situated on the medial side of the mandibular ramus, is anatomically and functionally a counterpart of the superficial portion of the masseter muscle. It is a rectangular, powerful muscle, though weaker than the masseter. Its main origin is in the pterygoid fossa. Anterior fibres arise from the outer surface of the outer plate of the pterygoid process. They extend their origin anteriorly to the inferior surface of the pyramidal process of the palatine bone and even to the adjacent parts of the maxillary tuberosity where they arise by strong tendons.

The fibres of the internal pterygoid muscle run downward, backward, and outward and are inserted to the medial surface of the mandibular angle. The field of insertion is approximately triangular.

The internal structure of the internal pterygoid muscle is complicated by the alternation of fleshy and tendinous parts, so that the muscle fibres themselves, arising from one tendon and ending on another, are arranged at an angle to the general direction of the muscle (Fig. 6). This arrangement,

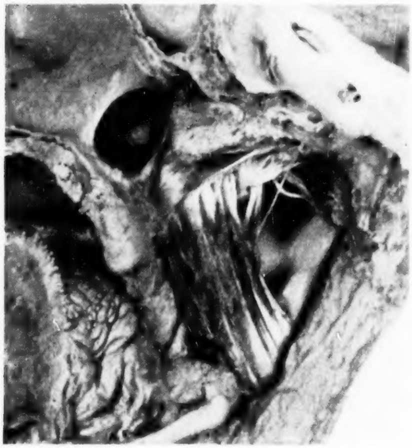

Fig. 6.—Note the alternation of fleshy and tendinous parts near the inferior end of the internal pterygoid muscle.

which gives to the muscle an appearance as if its fibres were braided, significantly increases the power of the muscle.

The internal pterygoid muscle is a synergist of the masseter muscle, especially of its superficial part, and therefore an elevator of the mandible. The assumption that the oblique direction of its fibres, downward and outward, enables this muscle to shift the mandible to one side in synergism with the external

Fig. 7.—External pterygoid muscle with its two heads. The articulation has been opened. The disc and its connection by loose darkly stained connective tissue to the posterior capsule can be seen.

pterygoid muscle is erroneous. In the lateral shift of the mandible one condyle and disc glide forward, medially, and *downward* on the articular eminence. A muscle that exerts primarily an *upward* pull can never cause or aid this movement.

The *external or lateral pterygoid muscle* arises with two heads. The larger inferior head originates from the outer surface of the lateral pterygoid plate, the smaller superior head from the infratemporal surface of the greater sphenoid wing. The fibres of the upper head run almost horizontally backward and outward in close relation to the cranial base. The fibres of the lower head converge upward and outward, the upper fibres running more horizontally, the lower fibres more and more steeply ascending. The two heads, separated anteriorly by a variably wide gap, fuse in front of the temporomandibular joint and can be separated only artificially (Fig. 7).

The uppermost fibres, comprising as a rule only part of the upper head, are attached to the anterior surface of the articular capsule and to the anterior border of the articular disc. The majority of the fibres, that is, part of the superior and the entire inferior head, are inserted to a roughened area on the anterior surface of the mandibular neck. It should be noted that only protracting muscle

fibres of the external pterygoid are attached to the disc; the retracting fibre bundles of masseter and temporal muscles are attached only to the mandible itself (Fig. 8).

The resultant force of the external pterygoid muscle is directed forward, inward, and downward. Therefore the two external pterygoids will pull the mandible and the discs forward. Unilateral action of this muscle will shift the mandible to the other side by pulling one condyle forward, inward, and downward.

Fig. 8.—Detail of figure 7, showing the relations of external pterygoid to the articulation.

The *suprahyoid muscles*, the digastric, the stylohyoid, the mylohyoid, and the geniohyoid, are arranged between the skull and hyoid bone (Figs. 9 and 10). Their function is either to elevate the hyoid bone, and with it the larynx, or to depress the mandible. Whether one or the other movement is effected depends upon the state of contraction of other muscles. If the mandible is fixed in its position by the action of the masseter, temporal, and internal pterygoid muscles the suprahyoids will elevate the hyoid bone and the larynx. If, on the other hand, the infrahyoid muscles, that is, sternohyoid, omohyoid, sternothyroid, and thyrohyoid muscles, are contracted, the hyoid bone is immobilized and the suprahyoid muscles that extend to the mandible will depress the lower jaw.

In a discussion of the mechanics of the temporomandibular joint the masticatory movements have to be considered as special movements which can be understood only if the "free" movements of the mandible have been analyzed. Free movements are those which occur without contact of lower and upper teeth. One could compare the distinction between free and masticatory movements of the jaw to a distinction between the movements of the leg in general and those carried out in walking.

Fig. 9.—Mylohyoid and digastric muscles. Above the posterior belly of the digastric the stylohyoid muscle.

Before the *movements* of the mandible can be discussed its typical positions have to be considered. It is suggested to differentiate three positions of the mandible, namely the *rest position*, the *occlusal position*, and the *centric position*.

Fig. 10.—Mylohyoid and geniohyoid muscles dissected from the medial aspect.

The free movements of the jaw start from, and end in, the rest position of the mandible. In this position the lower and upper teeth are not in contact; the distance between upper

and lower front teeth in the rest position varies as a rule from two to four millimetres. The rest position is constant in each individual due to the individually fixed and only slightly variable tonus of the masticatory muscles, which in their "relaxation" allow the mandible to drop slightly. The rest position is therefore not dependent on the presence of the teeth or on their shape or position but on the musculature and on muscular balance only.

The movements from centric position to rest position seem to be pure or nearly pure hinge movements. It is necessary to visualize the transverse hinge axis as passing approximately through the centres of the two condyles. The hinge axis is therefore not identical and does not coincide with the oblique condylar axis. Slight forward and backward movements of the condyle visible in the roentgenograms do therefore not necessarily contradict a hinge movement. Further studies are necessary to determine the reliability of roentgenologic examination of condylar movements.

The question has often been asked as to the forces that keep the mandible in rest position. It is, as was mentioned previously, the tonus of the masticatory muscles which does not allow the mandible to drop further and fixes individually the rest position. If muscles rest they do not relax entirely. Instead, a certain percentage of the fibres of an individual muscle remain in the state of contraction. In spite of the incapability of striated muscle fibres to keep contracted for any length of time, the muscle as a whole maintains the slight tonic contraction or tension, by groups of fibres relieving each other in short intervals. For each muscle and for each individual the tonus is fairly constant. It decreases during sleep and in chronic illness but it is reduced to zero only in deep anaesthesia or unconsciousness. The tonus may on the other hand, increase temporarily after strong, but not exhausting, activity of muscles. The function of the masticatory muscles in determining the position of the mandible is not unique. The contact of articulating bones under pressure in all joints of the body is maintained, at least in part, by the tonic contraction of the muscles around the joint.

The rest position of the lower jaw varies slightly in different positions of the head and neck. If the head is bent forward, the space which is occupied by the cervical viscera is narrowed. The compressed soft tissues push the mandible slightly upward and forward.

The reverse is true if the head is bent backward. Then the soft tissues stretching from the mandible to the clavicles and sternum are stretched, and especially the skin and the fascia pull the mandible slightly backward and downward.

Therefore, it is not only necessary to put the head into the same position in space, but also into the same relation to chest and neck, if the rest position of the jaw is to be compared at different times.

The position of the mandible in which the teeth are in contact is the occlusal position. Occlusal position under normal (or ideal) conditions coincides with the centric position of the mandible. Since, however, in a great number of individuals even a slightly abnormal position or wear of one or several teeth forces the mandible into a displacement when teeth are brought into occlusion, the centric position should be recognized as a distinct state of the mandibular relations to the cranium. It may be defined as that position of the lower jaw in which teeth, temporomandibular articulation, and musculature are in perfect balance. Whether in a given individual occlusal position is identical to centric position can be diagnosed by observing direction and extent of the path of closure from rest to occlusal position. Closure should be accomplished by a hinge movement and should not extend over much more than four millimetres.

In centric position the head of the mandible is opposed to the posterior slope of the articular tubercle and is not situated in the deepest part of the articular fossa. This seemingly labile equilibrium is maintained mainly by the interlocking cusps of the occluding teeth which prevent further movement of the mandible upward and backward despite the contraction of the masticatory muscles. The articular disc aids in stabilizing the position of the condyle, filling the space between the mandibular head and articular fossa. The varying thickness of the posterior part of the disc in individuals with a high or low articular tubercle explains why in centric position the head of the mandible is in a fairly similar relation to the height of the articular tubercle, regardless of the depth of the articular fossa; the deeper the fossa and the higher the tubercle, the thicker the posterior part of the disc. However, the disc is only a relative or accessory support for the mandible in occlusal position because the disc itself is movable against the temporal bone, and can act as additional support only if the upward and backward movements of the mandible and disc are checked by normal occlusion or normal muscular action. That the teeth participate in determining the position of the mandibular head should not be interpreted as meaning that there is not pressure in the joint itself.

The difficulties in understanding the mechanics of the temporomandibular articulation are caused mainly by the fact that the

movements of the mandible are not so much directed by the shape of the articulating bones and by the articular ligaments as in other joints, but to a far higher degree by the play of the muscles. That in spite of the great freedom of the mandibular articulation, the movements (for instance, masticatory or opening movements) are characteristic for, and constant in, each individual, is due to the automatic pattern of such movements just as, for instance, gait is characteristic of an individual.

If we prepare a specimen of the temporomandibular joints by removing all soft tissues, with the exception of the articular capsule, we find a surprising freedom and range of the mandibular movements which at first seem to contradict the orderly movements of the living. Careful investigation, however, shows that the freedom of movement in the living is exactly the same as that in the anatomic specimen. Only the range of movement in the living is somewhat restricted by the compression or stretching of soft tissues. Most individuals can learn to perform all possible movements, even those that are not normally executed.

Basically, two movements of the mandible can be distinguished: (1) the rotatory movement, a hinge movement of the mandible around a horizontal frontal axis, passing approximately through the centres of the condyles; (2) the translatory movement, a sliding of the disc and mandibular head along the temporal bone; the latter movement may be symmetrical or asymmetrical. The rotating movement of course occurs between the disc and condyle in the lower, the translatory movement between temporal bone and disc in the upper compartment of the temporomandibular articulation.

That mandible and disc slide forward together is commonly explained by the fact that the external pterygoid muscle is attached to the mandible *and to the disc*. It has to be pointed out, however, that the disc passively follows unstrained movements of the jaw since it is tightly fixed to the poles of the condyle. If muscular action would be necessary to protract the disc, the lack of a retractor of the disc could not be explained. It is furthermore known that also in the cadaver the disc follows the movements of the mandible though here only passive movements are possible (Fig. 11).

The capsular attachment of the external pterygoid muscle serves therefore more the balancing fixation of the disc than its movement. If the jaws are forcibly closed while a piece of food intervenes between the teeth, the position of the condyle and disc on the posterior slope of the articular eminence is in jeopardy. Only the external pterygoid muscle, by its active contraction, can prevent a backward displacement of the condyle and disc and maintains thus the correct relations between the three parts of the articulation.

The *functional* movements of the mandible are combinations of the *basic* movements: (1) the opening and closing movements; (2) the

Fig. 11.—Exact drawing of a section through a frozen head with the mouth wide open. The disc has passively followed the mandible to the height of the articular eminence.

symmetrical protrusion and retrusion, forward and backward movements; and (3) the asymmetrical lateral shift or lateral rotation.

The opening and closing movements of the jaw are a combination of rotatory and translatory components; that is, the lower jaw rotates around a frontal axis which passes approximately through the centres of the two condyles while the axis itself progresses in space. The translatory or sliding movement brings the disc and mandible forward and downward from the posterior slope to the height, in many individuals even to the anterior slope, of the articular tubercle. The rotatory movement is extensive and normally goes so far that the opening between the upper and lower teeth accommodates three fingers. Observation of the living easily proves the normal combination of translatory and rotatory movement of the lower jaw. If a finger is placed just in front of the tragus, it can follow the forward and downward sliding of the mandibular head. During the opening the soft tissues behind the moving capitulum sink in slightly and a shallow groove becomes well visible, especially on individuals with thin cheeks. The movement of the mandibular head

also influences to a slight degree the width of the cartilaginous part of the external acoustic meatus. If a finger is introduced into the passage of the ear, one can easily feel the prominence of the lateral pole of the mandibular head on the anterior wall of the meatus and the widening of the passage when the mouth is opened. The change has to be regarded as an active widening of the meatus during the opening movement of the jaw, rather than as a compression of the passage during the closing phase.

During opening or closing, the translatory and rotatory components are not evenly combined. The opening movement starts with an almost pure rotatory or hinge movement which depresses the mandible to or slightly beyond its rest position.

Fig. 12.—Roentgenogram and outline of the face. The lower jaw has been dropped in a pure hinge movement.

From then on the two components combine to a smooth movement. After maximal opening of the mouth, the closing movement commences with a phase in which the translatory component, that is the backward movement, preponderates. In this way, the mouth is closed to about two-thirds of the maximal opening and, at the same time, the head of the mandible is brought from the anterior slope to the height or to the posterior slope of the articular tubercle. The last two-thirds of the closing movement occur again in a smooth combination of translatory and rotatory movement.

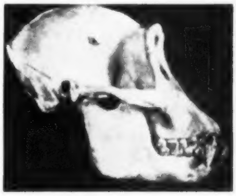

Fig. 13.—Skull of chimpanzee. Wide and free retromandibular space.

Until recently it was not believed possible that the jaw could be opened in a pure hinge movement. However, with some patience everybody can learn to execute this movement by actively repressing the forward sliding movement of the mandible (Fig. 12).

The jaws can then be opened—though under strain—in a purely rotatory movement to about two-thirds of the maximal width. This observation is the clue for the acquisition of the complicated opening

Fig. 14.—Skull of man. Note the narrow retromandibular space after the development of the mastoid process.

movement that is characteristic of man. In the chimpanzee, for instance, the opening occurs by a pure hinge movement. The mouth can be opened in this way because there is no bony element behind the mandibular ramus, and the soft tissues are not compressed by the moving jaw (Fig. 13). In man, however, the mastoid process developed and narrowed the retromandibular fossa, which was still more restricted by the forward bend of the posterior part of the cranial base (Fig. 14).

The curving of the cranial base as well as the development of the mastoid process are consequences of man's upright posture and gait. The restriction of the free space behind the moving mandible causes a restriction of the hinge movement of the mandible which is counteracted by a simultaneous forward movement, considerably widening the retromandibular groove. The external pterygoid muscle was utilized in the acquisition of the protrusive component of the opening movement. The combination of rotatory and translatory movement was therefore acquired and fixed as a neuromuscular phenomenon. Since this intricate movement is necessitated neither by the shape of the articulating bodies nor by the course of ligaments, the two component movements can be enacted independently.

The forward and backward movements of the mandible can be simple horizontal movements if the teeth are not in occlusion. From the rest position the jaw can be pulled forward quite extensively, the lower teeth remaining at a distance from the upper teeth. During this movement the mandible is pulled forward together with the articular disc; the movement occurs, therefore, in the upper compartment of the mandibular joints and is symmetrical. The reversal of the forward thrust is also mainly translatory.

Most individuals are able to pull the mandible slightly backward from its rest position, but this movement is possible only under some strain and against resistance exerted by tension of the capsule in front of the joint and compression of the soft tissues behind the condyle. This movement does not play any role in the physiology of the human mandibular joint. It demonstrates, however, the rather labile position of the mandibular head.

A lateral shift of the mandible results if only one condyle and disc are pulled forward on the articular tubercle. During this lateral shift or lateral rotation of the lower jaw, the mandible moves around an almost vertical axis, only slightly inclined downward and backward; the axis passes a few millimetres behind the condyle of the side towards which the chin deviates.

In lateral shift the path of any point of the condyle is at right angles to the axis of the articular eminence while it moves obliquely across the eminence in a symmetrical forward thrust. This is, of course, the consequence of the oblique position of the axes of the condyle and articular eminence. In a lateral movement of the lower jaw the "resting" condyle does, however, not rotate *in situ*, as was formerly believed, but moves also slightly forward and outward. This movement is known as Bennett's movement. The simplest way of defining it is to refer to the position of the almost vertical axis of the lateral movement as passing *behind*, and not *through* the "resting" condyle. The Bennett movement is caused by the presence of the posterior lip of the glenoid fossa in the lateral part of the articulation. If the resting condyle would rotate *in situ* its lateral pole would close in upon the postglenoid lip and would cause strain by compression of soft tissues. The resting condyle, therefore, slides forward just so far as to prevent this strain. More correctly stated, while one condyle moves forward, the other is held in an unstrained position by active muscle contraction. This is the reason why we can not swing the mandible laterally from a slightly protruded position without retracting the condyle on the side toward which the chin deviates.

A free lateral movement, that is, the movement in which the teeth are not in occlusion, starts as a rule from the rest position of the mandible. After some exercise, however, it is possible to swing the jaw laterally from its most forward position, even from the position of maximal opening. The mechanism of this movement is, of course, in some measure the reversal of the movement previously described. If the jaw is maximally protruded or if the mouth is maximally opened, the lateral swing is executed by pulling one condyle and disc back into an unstrained position, while the other condyle and disc are held in the forward position. If the lateral movement is attempted from a wide open position of the mandible, the movement is always combined with a slight closing movement.

The great freedom of movement of the lower jaw is expressed in the possibility of a circumductory movement. This means that the jaw can be moved from one extreme position into the other without returning to the rest position, thus outlining the limits of the free mandibular movements. Within these limits any point of the mandible can move freely in all three directions of space. The realization of this freedom of movement is of great practical importance because it proves that one point of the mandible of an edentulous jaw can be made to glide along paths of widely varied inclination if the plane only falls within the limits of the movements of the jaw. So far, the movement is independent of the individual shape of the articulating surfaces, especially of the inclination of the posterior slope of the articular tubercle.

If, however, the excursion of one point of the mandible (for instance, by establishing an incisal guide plane) has been fixed, the movement of any other point is now dependent upon *two* factors: the inclination of the plane arbitrarily fixed, and the inclination and shape of the temporal articulating surfaces.

Before discussing the masticatory movements of the mandible it is necessary to analyze the contribution of the different mandibular muscles to the movements of the lower jaw. These muscles may be divided into three groups: (1) elevators; (2) depressors; (3) protractors. The retractors do not constitute an independent group, but are represented by the posterior fibres of the temporal muscle and the deep portion of the masseter on one side, by the retracting component of geniohyoid and digastric muscles on the other. Thus elevators and depressors may combine to act as retractors.

The elevators of the lower jaw are masseter, temporal and internal pterygoid muscles. The resultant force of these muscles is directed upward and slightly forward and the position of the molars is such that their long axes coincide with the direction of the resultant force. The oblique position of the molar causes the upward curve of the occlusal plane in the molar region, the curve of Spee. The closing muscles do not act necessarily as one unit or as synergists. One has to realize that parts of any one of the muscles may and do act independently, a fact which explains the everyday experience that a muscle can act with different force. During weak action only a small number of the muscle fibres contract, whereas greater resistance stimulates the contraction of more and, finally, of all its fibres.

The depressors (and retractors) of the jaw are digastric, mylohyoid, and geniohyoid muscles. The action of these muscles, spanning from the movable hyoid bone to the mandible, is dependent on the changing position of the hyoid bone in relation to the mandible, with the exception of the almost vertical posterior fibres of the mylohyoid muscle in which the depressing component is not coupled with a retracting component. Digastric and geniohyoid muscles exert a fairly balanced combination of depressing and retracting power if the hyoid bone is fixed by the infrahyoid muscles in its lowest possible position. The further the hyoid bone ascends the more the retracting component will outweigh the depressing force. A similar change occurs if the hyoid bone is fixed and the mandible is lowered so that chin and hyoid bone are brought gradually into the same plane. This means a gradual weakening of the depressing components of geniohyoid and digastric muscles.

The third group of mandibular muscles is represented on either side by one muscle only, the external pterygoid muscle, which has simply a protracting effect upon the head of the mandible. Since this muscle is attached not only to the mandibular neck, but also to the articular capsule and the articular disc, the muscle will also influence the position of the disc.

The mandibular muscles combine in a rather complicated pattern to execute the different movements of the mandible. During the mandibular movements the external pterygoid muscle plays a leading role because it is active in many different movements. At no time does the external pterygoid muscle act alone and unaided. It is therefore erroneous to describe the external pterygoid muscle as *the* opener of the jaws. This becomes immediately clear if one considers that in two widely different movements the external pterygoids are active, namely in forward thrust and in the normal opening of the mandible. The end result of the contraction of the external pterygoids depends on the behaviour of the two other muscle groups, the elevators and the depressors.

The forward thrust of the mandible is the result of the active contraction of the external pterygoid muscle, slight contraction of the elevators, and relaxation of the depressors. The external pterygoid pulls the mandible and disc forward, while the elevating muscles act to maintain the relative position of the mandible to the maxilla, preventing a dropping of the lower jaw. While in an unresisted forward thrust the contraction of the elevators is not noticeable to the palpating finger, the contraction of the masseter can easily be demonstrated if the movement is carried out to the extreme forward position of the lower jaw.

In the retracting movement the deep portion of the masseter and the posterior fibres of the temporal muscle combine forces with the depressors, mainly with the geniohyoid and digastric muscles, while the elevating parts of the elevators are slightly contracted so as to maintain the position of the mandible in the horizontal plane. The depressing component of the suprahyoid muscles is of course neutralized by the stronger elevating force of the elevators. The participation of the suprahyoids in retrusion can be easily

demonstrated if this movement is attempted against some resistance or if it is continued beyond the rest position of the mandible. During retrusion the external pterygoid muscle is entirely relaxed.

The opening movement is caused by a synergistic action of the external pterygoid muscle and the depressor-retractors of the lower jaw. If the movement occurs without resistance, the depressors act without any great force and it is this fact which has prevented some observers from understanding the necessary contribution of the suprahyoid muscles in the opening movement of the jaw. The contraction of the suprahyoid muscles can be ascertained if the opening movement is extreme. The protracting force of the external pterygoid muscle acting upon the condyle and disc, and the simultaneous depressing and especially the retracting force of the geniohyoid and digastric muscles acting upon the chin, blend in perfect manner to execute the combination of rotatory and translatory movement.

In a normal opening movement the suprahyoids function more by their retracting component than by a true depression. They change, however, their direction as well as their power, if the opening is done against resistance, for instance, in fibrous ankylosis of the temporomandibular joint. The same is true after loss of the external pterygoid by fracture of the mandibular neck or by removal of the condyles. In such cases the hyoid bone is not only fixed in its position, but strongly lowered by the action of the infrahyoid muscles.

The closing movement is mainly the function of the elevators of the jaw. If the mouth was opened to its maximal extent the timing of the activation and relaxation of the different muscles plays an important role. It has been mentioned that, in maximal opening, disc and condyle glide not only to the height but in many persons even to the anterior slope of the articular tubercle. The "reduction" of this "physiologically dislocated" joint can be brought about only if the elevating component is delayed until the head and the disc have regained their position at or behind the height of the temporal convexity. This in turn is possible only if at the very beginning of closure the external pterygoid muscles relax. The first phase of the closing movement is enacted by a synergism of the retracting portions of the masseter and temporal muscles and the retracting components of the depressors which prevent the chin and, therefore, the mandible from moving upward. In this, the first phase of the closing movement, the mandible glides sharply backward without moving upward to a considerable extent. Then the powerful elevators finish the closing movement until the rest position or the occlusal position is reached. A disturbance of this intricate neuromuscular co-ordination, namely, a delay in the relaxation of the external pterygoids, is responsible for a pathologic dislocation of the temporomandibular joint. The mandibular articulation is the only joint in our body that can be dislocated by its own muscles without the action of an external force. This observation strengthens the belief that this articulation more than any other is dependent on the musculature as the directing force of movements.

The lateral rotation of the mandible is the asymmetrical variation of the forward thrust; that is, one external pterygoid muscle combines forces with the slightly contracted elevators. However, the contralateral retracting bundles of the elevators assist in this movement by holding the "resting" condyle in an unstrained backward position; that is, by preventing it from deviating anteriorly further than necessary to relieve or prevent compression of tissues behind the lateral pole of the condyle.

The masticatory movements of the lower jaw are automatic movements which occur under considerable force and under contact of teeth. Like other automatic movements, they are characterized by variability from individual to individual, but by great stability in each individual, a stability, however, that does not preclude a considerable adaptability.

Though following the human pattern of mastication, the masticatory movements vary in detail in different individuals. They are dependent on the shape and proportions of the jaws and of the teeth. Once established as an automatic series of movements, their pattern is maintained quite persistently. And still, loss of teeth or changes in their position are followed by a rather rapid adaptation of the movements in order to achieve maximum effect with minimum effort, that is, with the least waste of muscular energy. The adaptation of masticatory movements are best exemplified by dentitions that undergo a regular and extensive wear. In some Eskimo tribes, for instance, the cusps and the incisal edges of the teeth are worn off completely in a relatively short time and, still, masticatory movements do not only maintain, but even increase their efficiency. All this happens during a period of life in which the temporomandibular articulation is known not to change.

The masticatory movements are here described as starting from the centric position in which all the teeth are in an even contact and the mandibular articulation in balance. In this position the elevators of the lower jaw are actively contracted as distinct from the rest position in which these muscles are under tonic contraction. The movements of the lower jaw which are enacted under contact of at least some teeth are of two kinds: a cutting movement as, for instance, in biting off a piece of food, and a grinding movement in comminuting the food.

The cutting movement starts with a preparatory opening movement. The extent of the opening is dependent on the dimensions of the food. The next phase ends with an edge-to-edge contact of the incisors and is followed by the last phase, a shearing movement, while the jaw returns to centric occlusion. In the edge-to-edge position of the anterior teeth there is, in the normal dentition with moderate wear, no contact of any other teeth. Frequently, even the contact of the anterior teeth is limited to a contact of the incisal edges of the central incisors of the upper jaw with the incisal edges of the lower centrals and laterals.

The relations of upper and lower teeth during the last phase of the cutting movement are best understood if the movement is first studied in reverse. Because of the overbite of the upper incisors a movement from the occlusal position to the edge-to-edge bite of the incisors can not be a simple forward thrust. Instead, the occlusion of bicuspids and molars has to be unlocked by an opening movement while the incisal edges of the lower incisors glide along the lingual surfaces of the upper incisors. The rotatory component of this movement is, of course, the greater the more the upper incisors overlap, and this in turn is not only dependent upon primary individual variations but also upon the degree of wear. Only in cases of rather excessive wear of the incisors is the opening movement so insignificant as to permit contact of lateral teeth while the incisal edges meet.

The last phase of the cutting movement is the reversal of the movement as described in the preceding paragrapn; that is, from the edge-to-edge position of the anteriors the jaw is pulled backward and upward while the incisal edges of the lower incisors glide along the lingual surfaces of the upper incisors until the occlusal position is reached. Mechanically, the cutting movement is a shearing movement, with the upper and lower incisors acting as the two blades of the shears.

Very rarely, however, does the last phase of the cutting movement begin with an edge-to-edge position of the incisors. Most individuals start the shearing movement somewhat behind and above the upper incisal edges. This is probably one of the reasons of irregular wear in the civilized populations of our time.

The second type of masticatory movement is the grinding movement. To understand it, it is helpful first to analyze a lateral movement from the occlusal position under contact of lateral teeth. In a normal dentition this entails a combination of an opening with a lateral rotating movement. The integration of a vertical rotary component into this movement is necessitated by the overbite of the incisors and cuspids of the upper jaw and by the interlocking of the cusps of bicuspids and molars. Thus, a purely translatory movement is made impossible and the occlusion has to be unlocked by an opening movement. The degree of the depressing component is, as in the cutting movement, dependent upon the individual variation of overbite and height of cusps and, therefore, also on the individual degree of wear. Under normal conditions, a contact of the lateral teeth in a grinding movement can be maintained only on one side. If, for instance, the lower jaw is shifted to the right, the right molars and bicuspids remain in contact, the cusps gliding along the oblique slopes of their antagonists. The left bicuspids and molars, however, cannot be kept in contact; in other words, the articulation of the teeth during the grinding movement is not balanced. Only in some cases of rather extreme wear when the cusps have disappeared is this state of a "balanced" occlusion or articulation achieved.

The grinding movement starts with a preparatory free lateral movement of the jaw; that is, the lower jaw is depressed and swung to one side. The degree of the opening component depends on the size of the bolus of food. From this preparatory position of the mandible the jaw is forcibly brought back into occlusal position. The automatic execution of this movement leads first to a contact of the cusps of the lateral teeth of that side towards which the mandible has deviated. When this contact is established, the mandible is brought to its centric position under maintenance of contact between the bicuspids and the molars, the cusps of the lower teeth gliding forcefully into the grooves between the cusps of the upper teeth. Crushing and shearing forces combine for the effective grinding action.

In the grinding movement too, the preparatory phase rarely leads to a cusp-to-cusp relation, the last phase starting as a rule at the oblique slopes of the cusps of bicuspids and molars. This "abbreviated" masticatory stroke leads to an irregular pattern of attrition, the buccal cusps of upper and the lingual cusps of lower teeth bearing the brunt of work.

Both masticatory movements, the cutting and grinding movement, can, accordingly, be divided into three phases: the first or preparatory phase is a free movement of the lower jaw; contact of teeth is established only at the end of the second phase. The third phase occurs under contact of teeth and is therefore a truly articulatory movement; it leads the mandible back into centric position. The first phase does not require any force; force is applied only during the second and third phases, the masticatory stroke in a strict sense.

The muscle balance during the second and third phases is of greatest importance because the closing movement occurs under great force while the teeth, separated by the bolus of food, cannot stabilize the position of the mandible to the disc and of mandible and disc to the posterior slope of the articular eminence. The powerful holding force of the external pterygoid is necessary to prevent a displacement of the mandible while its condyle is precariously balanced by the disc on the posterior slope of the articular eminence. The external pterygoid has to maintain the balance of the articulating bodies, and the insertion of muscle fibres to the disc serves this important function.

Since the temporomandibular articulation is a freely movable joint, it should be clear that the masticatory movements are dictated by the position and the shape of the teeth. Since the positioning of the teeth during eruption is dependent on the movements of the jaw, we are confronted here again with that type of interdependence of form and function that can be recognised in all parts of the animal body.

Some Fallacies Associated with Children's Dentistry

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1. THE DENTIST WHO DOES MUCH WORK FOR CHILDREN MUST LOVE THEM AND ENJOY THEIR COMPANY.

Any adult who prefers the company of children to that of other adults must himself have a childish mind. Therefore the mere fact of doing dentistry for children does not necessarily mean the dentist enjoys their company.

The average adult, particularly the male, soon gets bored when left alone with young children; parents even get tired of their own children. Most fathers when alone with their children for some hours find themselves longing to talk to an adult. They even get short-tempered.

The incessant chatter, questions, fidgeting; the fighting, sulking, boasting, all start to bore after a short time. This is easily understood, for children's behaviour is more fundamental, because they have not developed so many of the inhibitions that make up the normal social conduct of the adult, and so are unable to hide their feelings or suppress their desires. Therefore, to work with them control is necessary. Control of the situation and the child must become an easy and certain fact. When this occurs work for them becomes preferable to that for adults. With children one can make the situation comply with one's mood. In a general practice the dentist has to comply more with the moods of the patient, especially if they wish to have full upper and full lower dentures made.

Many dentists consider that the pedodontist must be a combination of Father Christmas, a Radio Uncle, and a Christian Saint—oozing with kindness, with unlimited patience, and spending most of his days telling fairy stories. If they feel these qualities lacking in their own mental make-up, they consider that they are unable to carry out satisfactory children's dentistry.

This is based on false premises, because success with children does not require any great love for them; in fact, I feel it would be a hindrance, because one's work should be entirely unemotional. As soon as emotional factors come into play the operator's judgment and skill are affected. Of course, the dentist must have respect for children and a desire to help them, yet he must always show that he expects obedience and co-operation.

This is best done by being quite natural and, if necessary, telling a child what you expect. Never use baby talk. Bernard Shaw can tell you why much more effectively than I am able to, when speaking of his own childhood: "Certain persons used to adapt themselves to my childishness by patting me on the head and talking in what they deemed a childish way to me; and I remember how I resented the personal liberty and despised the unbecoming and offensive imposture. They all made the same mistake. Instead of being natural, in which condition they would have been quite childish enough to put me at my ease, they affected imbecility—a very different thing to childishness, and open to instant detection by any sane infant."

Success with children depends entirely on confidence in one's ability to handle them; nothing in life can be done well if a person doubts that he can do it. This leads to our second fallacy:

2. THAT CHILD CONTROL IS

(a) AN INBORN QUALITY—you either have it or you haven't it.

(b) DIFFICULT.

The ability to handle children can be acquired in a short time; the only quality that might be inherited and would help is patience, and even this can be cultivated and improved with experience and practice.

How do we go about getting it?

Firstly, by following certain rules and knowing exactly what to do under certain circumstances. In this regard it is the same as any technical procedure and should be regarded as such. Therefore it is essential to know what one's procedure is to be and not to hesitate to apply it. When the procedure for any circumstance is known, confidence comes, unlimited amounts of superconfidence, and this in turn spells the doom of any child who might feel tempted to be difficult.

Secondly, by having some knowledge of the fundamental human urges and their control. Brase quotes Thomas[1] as naming these as:

(1) The urge for security.

(2) The urge for response (affection).

(3) The urge for recognition.

(4) The urge for new experience.

If these urges are fundamental they will be working strongly in a small child, and a little thought will show how they can be utilised in helping to control the child.

Anderson[2] states that a fundamental precept of human conduct is that all conduct is purposive towards the well-being of the organism or, what amounts to the same thing, the elimination of unfavourable circumstances. This is natural, for any organism without this urge would be helping to commit racial suicide. Therefore the difficult behaviour of a child who has been, is being, or fears being hurt in a dental surgery is quite natural, and the simplest way of stopping it is to show him that the thing he fears does not in fact exist. This brings us to the most important fact in child control, viz., pulpal anaesthesia.

Child control in my hands depends on:

(a) Pulpal anaesthesia.
(b) "Horse sense."
(c) Keeping mother out of the surgery.
(d) The "towel technique."
(e) Confidence.
(f) Souvenirs.

(a) *Pulpal anaesthesia.*

What makes child control necessary? Pain. Would we need it if a visit to the dentist was as painless as a visit to the barber? Would dentists under these circumstances be telling parents that it is unnecessary to preserve and fill deciduous molars? Of course not. Yet we have methods whereby teeth can be made quite insensitive, and so the first and most important factor in control is an effective local anaesthetic technique. My most satisfactory method is the intra-osseous technique[3]. Once the technique is acquired all cavity preparations for all children can be painless.

(b) *"Horse sense."*

It is difficult to say much about this, and it really means being sensible and doing the right thing at the right time in handling children. It is the least important of our factors as it largely depends on experience and will come as one deals with more children. The other factors are essential from the beginning whereas "horse sense" is not, but once acquired will make work much simpler.

(c) *Keeping Mother out of the surgery.*

It is impossible to control a difficult child with the mother present, because all the dentist has is his voice, and the crying child is giving his whole attention to the effect his crying is having on the mother. The mother is "highly strung," although she has probably told you that the child is. The child has learnt from infancy that certain behaviour (tantrums) has brought about a certain result (getting his own way). This behaviour has formed an evergrowing behaviour pattern in the child which is making him obnoxious and

his mother neurotic. Let them enjoy their peculiarities at home, but keep them away from your surgery. If the mother is present the child's attention is focussed on the effect of his behaviour on the mother, and anything the dentist might say is futile and useless. However, when you have the child alone you can make him listen to you. The young dentist would be wise to exclude all mothers from the surgery during operative procedures. With the passage of time and an increase in confidence it is possible to allow some mothers in the surgery. But remember—if in doubt keep mother out!

(d) *The towel technique.*

This is the method to be used with the screamer who is entirely unco-operative. The technique is described in most textbooks on children's dentistry and will stop any five-year-old child from crying in three minutes, or even less. It can be used upon any unco-operative child over three years, who is afraid, obstinate, or just plain spoilt. Once he opens his mouth, however, a local anaesthetic must be used, because the towel technique depends on using force to compel the child to submit, so that he can be shown that there is no pain associated with what he fears.

Note that it is called the towel technique[4, 5] and it should be regarded as such: something that is done in a certain way to obtain a certain result.

(e) *Confidence.*

Controlling children is the same as controlling animals. If they sense that you are frightened of them the work becomes more difficult or even impossible. Therefore do not be afraid of a child. Look him straight in the eyes, talk to him as you would an adult, never raise the voice or sound impatient, because when he knows you are rattled his bad behaviour will get worse.

Confidence grows with experience, and as it grows the number of children who give trouble will get less. Little is known of the human psyche, but it is a fact that children know how an adult is feeling and seem to get some satisfaction from the fact that they are able to upset them. Do not take this fact too lightly, for even infants a few weeks old have the same faculty. We all know of infants who will not feed, "lazy at the breast" they are called. The mother becomes upset and then panicky. The more she worries, the more obstinate is the infant. It ends up by not feeding at all. Yet, take the child away from the mother and place it in the care of a person who does not mind whether it eats or not, and in a week it will be feeding as well as any other child.

Therefore, develop confidence and you will find few children who are troublesome, for the child seems to take on some of this confidence for himself, or perhaps he senses that it will be useless to make a scene.

(f) *Souvenirs.*

For five years now I have been giving every young child a threepence after every visit that entails operative work. The attitude of the children and information received from mothers show it to be a worthwhile procedure, as it does make the children anxious to come again. It has never been given as a reward for good behaviour because, as already explained, this must be demanded by our attitude. Sebelius[6] states that "it seems logical to conclude that the practice of rewarding good behaviour in the dental office is not justified." However, he concludes that souvenirs may serve as practice builders; "since souvenirs make a visit to the dental office more exciting, the child may anticipate a visit with pleasure rather than anxiety, and may consider the visit an important event."

3. That Local Anaesthesia is Contra-indicated Because Pain is Necessary as an Indication of Closeness to the Pulp, and Because the Heat Generated by the Burr Will Kill the Pulp.

Those dentists who put forward these propositions should satisfactorily answer the following questions:

What evidence is there to show that the closer one gets to the pulp the more sensitive the dentine becomes?

What method is used for measuring the increase in pain as the pulp is approached? Do their patients blink their eyes more, groan louder, look towards the door, or is there some secret physiological test or apparatus for measuring the increase in suffering?

What do they do in the case of patients with completely sensitive dentine no matter what part of the tooth is being drilled? They would have to assume nearness of the pulp as soon as the dentine is penetrated.

Or vice versa.

In the case of patients who never give any sign of pain they could assume a pulp does not exist.

Is not Fish's dead tract, under which an exposure is most likely to occur, practically

insensitive[7], and is not pain more acute in non-carious dentine on each side of the affected tubules?

I think the real reason for this claim is dislike of local anaesthesia based on:

(a) Failure to get complete pulpal anaesthesia.

(b) Disorganization of appointments waiting for the more commonly used local anaesthetic techniques to become effective, and the time lost in so doing.

As for the heat generated, any dental surgeon who gives this as a reason for not using local anaesthesia is only condemning his own operative ability and technique.

4. That Silver Amalgam is the Filling Material of Choice for Deciduous Molars.

This claim is frequently made in articles on restorative dentistry for deciduous molars, without any actual reasons being given for the statement, and I once subscribed to the view myself. Excluding inlays which would be the ideal but because of the financial factor are not satisfactory as a routine, the only other filling material is copper amalgam. Why is this so firmly condemned? What undesirable properties does it possess as a filling material?

(1) Probably more likely to fracture during removal of a matrix than is silver amalgam.

(2) Slowness of setting with a possibility of fracture during this time. However, if the opposing cusps are ground, the mix dried while packing, and care taken to see the fillings are free of the bite, this is not very likely to happen.

(3) Solubility in the oral fluids with a possibility of leaking fillings and lost contact points. Because the fillings are not expected to last more than six years, this is no serious disadvantage. This property is also responsible for the germicidal effect which is often of some benefit.

What advantages has copper amalgam over silver amalgam?

(1) It has much greater crushing resistance, and once set a Class II restoration is much less likely to break at the axio-pulpal line angle than with silver amalgam.

(2) Copper amalgam fillings do not need to be lined except in the deepest cavities, while all silver amalgam fillings need lining. This statement will probably not be believed, and the only way you can verify it is to do it for yourself and see that no complaints come from mother or child, and that pulps do not die.
Schoonover and others[8] have shown that electrolytic action between water and the zinc that is usually present in silver alloys produces a secondary expansion of 300-400 microns per centimetre in the amalgam some days after mixing. If no moisture is present the expansion is only of the order of 8 microns per centimetre, and this occurs 10-20 hours after mixing. The excessive expansion is due to the liberation of hydrogen gas within the mixed amalgam, and the pressure exerted is of the order of 1600-2000 lbs. per square inch. These facts fit in with the clinical picture of the unlined silver amalgam filling, i.e., excessive pain 7-8 days after the filling is inserted whereas during the first few days no discomfort is noted, and that is the reason that nearly all silver amalgam fillings need lining, preferably with some form of zinc oxide and eugenol mixture.

(3) Copper amalgam does not expand after setting, there being no dimensional change, although a small contraction may occur; therefore, margins stay exact months and years after placing the filling. This lack of expansion is also the reason for the good reaction on the part of the tooth, even when the fillings are not lined, suggesting the oft-repeated fact that we line amalgam fillings because of insulation reasons is yet another fallacy.

5. That Copper Amalgam is the Ideal Filling Material for Deciduous Molars.

Many dentists appear to be of this opinion, for they place it in cavities where nothing but the ideal filling material would have a chance of remaining or doing much good; and as the ideal filling material has not yet been found these restorations are doomed from the very beginning. This, I consider, is the reason copper amalgam is largely condemned, but the fault lies in the cavities in which it is placed; silver amalgam would probably be even worse under the same circumstances.

It is essential that copper amalgam be placed in correct cavities with resistance form, retention form, and all caries removed; and a satisfactory steel matrix used in the case of Class II cavities.

6. That the Anatomy of the Deciduous Molars Makes the Cutting of Correct Cavities a Hazardous Procedure.

The size of the pulp in these teeth relative to the size of the crown is certainly larger than the permanent dentition; and the pulpal horns are relatively longer. However, this does not mean that the pulp is lurking just beneath the enamel ready to pounce on the dentist who is foolish enough to penetrate into the dentine. This view is propagated in text-books. Nuckolls[9] in a comprehensive study of the morphology of the deciduous teeth says: "the mesial surface of the maxillary first deciduous molar is unfavourable for a mesio-occlusal preparation" and "the mesial surface of a maxillary second deciduous molar, because of the relatively long buccal pulpal horn, is unfavourable for cavity preparation." These are unnecessarily gloomy statements, as such cavities are cut in these localities in a pedodontic practice by the hundreds every year without any difficulty.

As long as one is careful and thinks a little while cutting cavities, exposures will be kept at a minimum; the mesial end of mandibular first molars is the position where an exposure is most likely to occur. As a general rule it can be said that with Class II cavities the proximal step can be safely cut with a No. 3 fissure burr in second molars and in first molars with a No. 2. These sizes are adequate to cut satisfactory cavities. On the occlusal surface strength must be obtained at the expense of width rather than depth, and at the junction of occlusal and proximal portions it is wise to widen the cavity with a No. 8 inverted cone burr.

7. That Children's Dentistry Does Not Pay.

This fallacy is widely held and in many practices it may be the case, but it need not be so. With the use of local anaesthesia and proper discipline in the surgery it is a simple matter to complete two deciduous restorations in a half-hour appointment, which is seldom the case with an adult or even in the older children when restoring the permanent dentition. Also, most young children present with two proximal cavities in the contiguous deciduous molars, it being the exception to find one proximal surface carious and not the other. Therefore the fee per time basis is much better for the 4-7 year old than for the older children or adults. This, combined with the very low overhead when treating children, makes restorative work pay very satisfactory financial dividends.

This leads to our last fallacy:

8. That Dentists Must Amuse Children.

The dentist's work should consist entirely of dental services; it is not his function to amuse children. If the parents wish their children to be entertained let them increase the profits of Walt Disney or Wirth Bros., and not expect the dentist to do it free of charge. This is largely responsible for our previous fallacy; dentists waste too much time telling fairy stories, giving rides in the chair, putting bunny rabbits on the engine belt, and trying to convince children their dentine is insensitive because it is only a little busy bee, and not a No. 2 fissure burr that is hurting them. And why all this old-fashioned hocus-pocus? Because we are trying to cajole the children into submitting to pain, and know before we even start that we may not succeed, all because we refuse to use a modern method of preventing the pain.

If I have laboured the point of local anaesthesia for children, and castigated the fairy-story teller, I apologise, but as I was one myself in the past, and slowly getting tired of the whole stupid business, I can really appreciate the difference that local anaesthesia and discipline can mean in a children's practice. So eliminate all this time-consuming, profit-wasting nonsense; use local anaesthesia, and endeavour to make every hour consist of an hour's dentistry. You will find that children's dentistry is simple, satisfactory, and far less exhausting on the cerebral cortex and autonomic nervous system than trying to please all types of neurotic adults.

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Bimaxillary Protrusion*

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This paper, entitled "Bimaxillary Protrusion", has been prepared for the benefit of those practising Orthodontics and therefore no attention has been paid to the normal routine procedures, but rather to the more advanced aspects of the subject, particularly those of a controversial nature.

"Bimaxillary protrusion" in orthodontic cases has been defined as "that form of malocclusion in which both maxillary and mandibular dentures, either as entire units or in one or both buccal segments, are in an abnormal forward relationship to their basal bones."[1]

This terminology is, however, not generally accepted and many orthodontists prefer to differentiate between bimaxillary prognathism, the condition found in the untreated case, and bimaxillary protrusion, a similar condition found, in some cases, upon the completion of orthodontic procedures.[2]

It is not at all surprising that orthodontists of the calibre of Lewis and Margolis should question the term "bimaxillary protrusion," but it does seem strange that the alteration they have considered so essential should rest solely on the word "protrusion." The word "bimaxillary," at its best, refers to two maxillary bones without making any reference to the mandible.

Then again, it would seem that the above definition attempts to cover what might conceivably be two different types of conditions, their only similarity being that by some operators they are treated by the reduction of tooth material.

Accepting the term "bimaxillary protrusion" for the moment it might be possible, in consideration of this similarity, to make some generalised statement such as, bimaxillary protrusion is that condition in which some reduction of tooth material is required in order to bring about either a more pleasing axial inclination of the incisors or a more satisfactory functional occlusion of the posterior teeth.

It has been inferred that any overlapping of contacts is evidence indicating an inadequacy of supporting bone, but there is every possibility that other factors and forces can upset the delicate contact relations which we think of as normal.[3] Amongst these are eruption and growth. Just as in the eruption of the teeth, so in the growth of the jaws we find great variation between different individuals. These variations are those of rate and time. An individual who is destined to be large may grow at a higher rate or he may merely grow for a longer period of time. Thus we may have precocious eruption of teeth associated with an average rate of growth or a normal eruption associated with a slow rate of growth, both of which would lead to temporary disharmonies in the tooth-jaw ratio. Hence, until it is possible to read individual growth curves and make accurate predictions as to the cessation of growth there is no way of determining, in the child, whether the arch will or will not hold its full complement of teeth.

An "abnormal forward relationship" of the buccal segments may very easily be brought about by the premature extraction of the deciduous teeth, resulting in the permanent canine teeth either being completely blocked out of the arch, mesially tipped, or carried bodily forward over the lateral region; the axial inclination of the incisors, however, being more or less normal.

On the other hand that type of case exhibiting a marked labio-axial inclination of the maxillary and mandibular incisors, and thought to be brought about by a disparity between tooth and jaw size, may not exhibit any such mesial migration of the posterior segments. This fact is borne out by the research work of Baldridge, Elman, Margolis, Brodie, Broadbent and Brash.

A study of the maxillary molars, particularly the first permanent molars, by Baldridge,[4] would seem to indicate that these teeth assume relations that are among the most stable in the face.

Elman[5] has shown that in Class 1 and Class II malocclusions the distance of the last mandibular molar in occlusion from the posterior margin of the ramus, on a line parallel to the occlusal plane, is the same for second deciduous molars as for the first and second permanent molars. In other words, each succeeding molar erupts at the same distance from the posterior margin. Also, regardless of age or of the stage of eruption, the ratio between the distance of the tooth anterior to the ramus and the distance of the

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tooth above the lower border is the same, that is, a ratio of 3 : 2.

Margolis states that a definite relationship seems to exist between the axial inclination of the mandibular incisors and the incisor mandibular plane angle; hence it would seem that the axial inclination of the lower incisors is a part of the individual's facial pattern.[5] This pattern, as demonstrated by Broadbent,[6] changes very little during the life of the individual.

Brash,[7] in the light of his madder feeding experiments, states that, although a mesial migration of the posterior segments has been postulated as a probable cause of crowding, he has found no evidence of such a movement of the molars in a forward direction in the alveolar border.

In view of the above evidence it would appear that in any Class I or Class II "bimaxillary protrusion," uncomplicated by the premature loss of the deciduous teeth, the relationship of the molars and incisors must be considered fixed or predetermined.

Thus it may be assumed that there are two types of "bimaxillary protrusions", one produced by some misadventure in post-natal life in which a mesial migration of the posterior segments is recognised but exhibiting no marked abnormal axial inclination of the incisors, and the other characterised by the so called "toothy appearance" which is the predetermined facial pattern for the individual.

It would appear that no one term can be applied to two such conditions, but, if they must be named, the terms "bimolar protrusion" and "bi-incisal prognathism" would seem to be both apt and descriptive.

Whilst the treatment of these two conditions does follow along similar lines, the final retention and prognosis may be different.

In the first case very little lingual movement of the incisors has to be brought about, but in the latter the anterior teeth are moved lingually to a marked degree, thus upsetting the muscular balance between the tongue on one side and the lips on the other.

Hence the closing of spaces in those cases of bi-molar protrusion would, in all probability, be purely a mechanical problem, but in those cases exhibiting a bi-incisal prognathism it may be both a mechanical and a physiological one, and therefore more prone to collapse.

These types of cases are usually found in Class I malocclusions, but they do occur as a complication in Class II's, and rarely in Class III malocclusions.

The diagnosis of these cases at an early age is of great practical importance and it is here that the techniques of Hays Nance[8] and Ballard and Whylie[9] come to our assistance.

In the mixed dentition the regulated extraction therapy of Nance does bring about successful results, especially in Class I cases.

In the permanent dentition two courses of treatment are open to us, firstly, extractions with or without removable appliances and, secondly, extractions plus active orthodontic treatment. It is with the various aspects of this latter type of treatment that this lecture is concerned.

Extraction of Teeth.

The actual teeth to be extracted, in this method of treatment, are more or less agreed upon and depend on the condition of the first permanent molars and the extent of crowding of the mandibular incisors. Some difference of opinion does occur, however, upon the extent of closure of the bite resulting from the removal of either bicuspids or molars.

The removal of the four first bicuspids is a solution advocated if the first permanent molars are not carious or heavily filled and the lower anterior teeth exhibit a certain degree of crowding. If, however, these incisor teeth display no irregularity the extraction of the mandibular second bicuspids is to be preferred.

While this method is to my mind ideal there are many orthodontists who consider that far less closure of the bite occurs with the extraction of the four first permanent molars.

A cursory study of the mandibular movements, in an edentulous patient, would seem to indicate that any slight closure of the jaws in the tuberosity region would be magnified enormously in the anterior region. Hence, it seems only reasonable to suppose that, if a closure of the bite does occur with a bi-lateral extraction of a tooth in both jaws, the distance from nasion to gnathion would more likely be affected by the removal of those teeth furthest away from the line N-Gn.

A study of the biting force charts, plotted from gnathodynamometer readings by Worner and Anderson,[10] would seem to indicate that an additional twenty pounds biting force can be exerted by the first permanent molars over and above that recorded by the first bicuspids; hence it would seem that if the best functional result is desired of our orthodontic cases the six year old molars, which yield the maximum biting force, should be kept intact.

Throughout this paper, unless otherwise specified, it will be understood that the four first bicuspids are the teeth chosen to be extracted.

Retraction of Cuspids.

This phase of the treatment is not commenced until the application of the .021" x .025" edgewise arches, in both the mandibular and maxillary dentures. Distal tipping bends are incorporated in the 5, 6 and 7 regions and stops are bent approximating the buccal tubes, in an endeavour to prevent any mesial migration of the posterior segments.

Numerous methods have been devised for carrying out the retraction of these teeth and in no other orthodontic problem has there been such originality of design. The underlying basis of each method however, is to exert a constant force along the line of the archwire in an endeavour to retract the cuspids in between the two cortical plates of bone.

The efficiency of these auxiliaries has, for the most part, been gauged by the rapidity with which the distal movement of the cuspids has been brought about, without any consideration being given to the fact that the larger the force the more likelihood there is of the somewhat inadequate anchorage breaking down. No attempt has been made to estimate the amount of force exerted by these appliances or, for that matter, how little pressure is required to bring about the distal movement of one tooth.

One of the original methods devised for the retraction of the cuspids is the U-shaped traction spring attached to the cuspid band. The free end of this traction spring is bent in the form of an eyelet and is made of such a length as to extend just below the location of the archwire.

This auxiliary has two main advantages, firstly, no soldering to the arch is required and, secondly, by bending the free end buccally, so that it presses against the arch wire, it can be used to rotate or move the canine lingually once it is free from the lateral incisor tooth.

Another device frequently used for the retraction of these teeth is the "safety pin" spring. This spring is soldered to the gingival portion of the archwire and contains either a single or a double safety pin bend. The free end, which is formed in the shape of an eyelet, occupies a position just occlusal and lingual to the arch wire, as shown in figure 1.

Fig. 1.—Single and double retraction springs.

Coil springs may also be used to advantage. In the mandible, distal movement of the cuspids is brought about by a continuous coil spring segment being placed, on the arch, between the cuspid brackets. In the maxilla, however, small segments of coil spring are used, these being activated through the medium of stops, soldered to the arch distally to the laterals on either side.

Many operators, particularly those associated with the Tweed school of thought, prefer to retract the cuspids through the medium of partial edgewise archwires. Numerous types of spring loops have been incorporated into these arch segments, a few of which are illustrated below. (Fig. 2.)

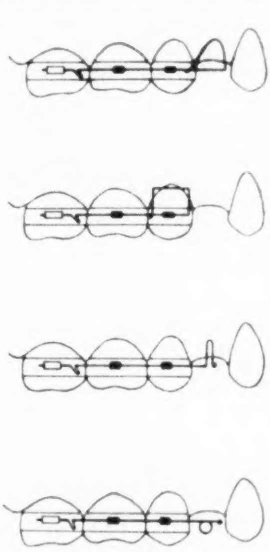

Fig. 2.—Partial archwires.

The main disadvantage of this technique lies in the depression of the second bicuspids. This is prevented, for the most part, by the use of vertical elastics adjusted from the upper to the lower loop. Once this depression has occurred, however, considerable difficulty is experienced in completely eradicating it from the line of occlusion.

Other operators have devised partial arch-wire segments constructed of .016" stainless steel wire, used in conjunction with the continuous edgewise arches. These archwires, two of which are shown in figure 3, are

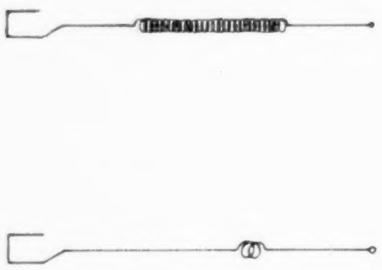

Fig. 3.—Partial archwires used in conjunction with continuous arches.

adapted to fit around the buccal tubes, beneath the distal end of the archwire, and are activated through the medium of ligatures tied to a staple on the disto-gingival border of the cuspid band.

A further type of partial archwire has been designed in an endeavour to bring about a bodily movement of the cuspids. This consists of a small segment of .016" stainless steel archwire conformed in such a way that it passes beneath the occlusal and gingival bracket wings. The free end passes mesially over the gingival tissues. This auxiliary is activated by a ligature tied to a spur which is soldered to the arch mesial to the second bicuspid, as illustrated in figure 4.

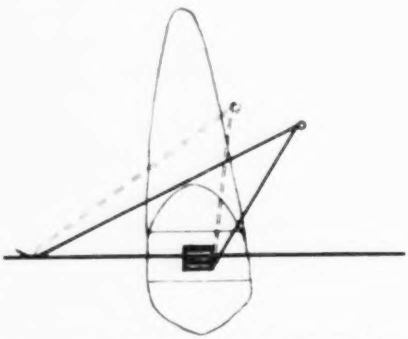

Fig. 4.—Partial archwire passing beneath occlusal and gingival bracket wings.

The above eleven methods illustrate how diverse are the opinions of orthodontists as to the best means of bringing about this particular type of tooth movement.

RETRACTION OF INCISORS.

When the cuspids have arrived at their destination and have been given a mild distal axial inclination the retraction of the incisor teeth should be commenced.

Perhaps the most common method of carrying out this procedure is by the use of the double vertical spring loop. These loops are incorporated in the edgewise archwire and are located as close to the distal edge of the lateral incisor brackets as is practical. The appliance is activated by means of ligatures that pass from traction spurs, soldered to the archwire mesial to the anchor teeth, backward round the posterior end of the buccal tube.

Three points should be kept in mind when using this appliance: firstly, the distal tipping bends in the buccal segments of the archwire should be located as close to the distal bracket wall as possible; secondly, the anterior leg of the vertical loop should be shorter than the posterior one; and lastly, if the incisors show a labial axial inclination it is desirable to round off the edges of the archwire in the incisal area.

The vertical spring loops, on either side of the denture, are alternatively reactivated until the spaces between the cuspid and lateral incisors are closed.

A second method of retracting the incisors, following the distal movement of the cuspids, is as follows:—

An .0215" x .028"stabilising maxillary arch is adjusted passively to the maxillary denture. The distal tipping bends are slightly increased and the arch is ligated into position.

An .020" arch is adjusted passively to the mandibular denture with the distal tipping bends incorporated just distal to the bracket markings.

Class III elastics are now commenced, with a head-cap on the maxilla to give added stabilisation, to move the mandibular incisors into contact with the cuspids. The cuspids and incisors are then moved further distally into their correct positions.

These archwires are then removed and replaced with an .020" arch in the maxilla and an .0215" x .028" in the mandible.

Class II elastics are now worn carrying the maxillary incisors, and then the cuspids with them, as far distally as is desirable. Head-gear is used at night on the maxillary denture.

In most cases the mandibular incisors and cuspids are now in their correct relationship to basal bone but there exists a space between the canines and second bicuspids. To overcome this the archwire should be repeatedly

tied back, thus bringing about a lingual movement of the incisors and a mesial migration of the posterior teeth. If, however, spaces still exist these can be eliminated by the use of two new .021" x .025" archwires in which are incorporated vertical spring loops between the cuspids and second bicuspids on each side. The anterior legs of these loops are made shorter than the posterior ones to reduce the overbite, but no distal tipping bends are made in the cuspid, bicuspid, or molar areas. Complete closure of the spaces is effected with these archwires, and correct axial inclinations are minor adjustments properly perfected.

Approximation of Cuspid and Bicuspid Apices.

At this point in treatment, even though the axial inclination may appear to be correct in the cuspid and premolar areas, X-rays will show the apices of these teeth to be far apart. It is thought by many that, unless some approximation of the roots of cuspid and second bicuspid is brought about, these teeth will tend to separate once the appliances are removed. One method of achieving this apical approximation is to adjust safety-pin sectional archwires between the cuspids and second bicuspids of both dentures. These are made of .021" x .025" arch material and should be adjusted passively as far as the bucco-lingual relationship is concerned. In each case a figure-of-eight ligature wire connects the brackets of these two teeth, thus holding the crowns in contact so that all the action of the safety-pin archwire will be received on the roots. This adjustment is continued until there is a slight mesial axial inclination of the cuspids and a slight distal axial inclination of the second bicuspids, thus assuring a close approximation of the root apices of these two teeth.

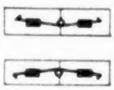

Fig. 5.—Safety pin sectional archwires.

A second technique, devised by Strang, to bring the apices of the cuspids and second bicuspids together, is as follows:—Tip-back bends are made in the molar and bicuspid regions in the usual manner. The first bend mesial to the bicuspid is likewise normal, but the second one, which is directed occlusally, is reduced in degree to the extent of five-sixths of the previous amount. Thus the canine bracket area will no longer be parallel to the molar and premolar bracket areas, but will have a gingival deflection. Mesial to the cuspid bracket the first bend is made occlusally at an angle of 45°, the second one being in a gingival direction of such a degree as to restore a uniform horizontal alignment of the archwire in the incisal area. This archwire adjustment is illustrated in figure 6.

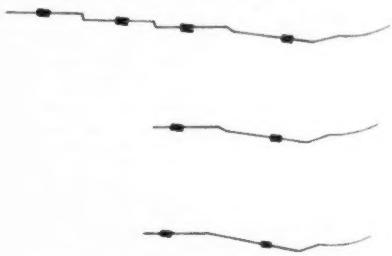

Fig. 6.—Archwire modification to bring about apical approximation of cuspid and second bicuspid, showing initial and final archwire adjustments.

When this wire is placed in the mouth it will be noticed that it is harmonious with the planes of all the bracket slots except those of the cuspids. It will cross the cuspid bracket slots in such a manner as to activate a reduction of the distal axial inclination of these teeth. By gradually increasing the angle of the bends that are posterior and anterior to the cuspid teeth, a mesial axial inclination will be evolved for these dental units.

If the crowns of the cuspid and second bicuspid teeth show any tendency to separate during this adjustment, a figure-of-eight ligature should be placed on their brackets and strongly tightened.

While both of these methods, from a purely mechanical standpoint, are most efficient, it must not be forgotten that any upset in the physiological muscular balance will tend to bring about a relapse, in spite of all the precautions to the contrary.

If the case is a Class I malocclusion the treatment is now complete. In Class II cases, however, the distal movement of the maxillary teeth *en masse* must now be begun.

Treatment of Class II Cases.

While the above form of treatment is applicable to Class II cases, it is highly desirable to commence Class II intermaxillary elastic traction before the spaces on both dentures are completely closed. This can safely be done when the incisors are nearly in contact with the cuspids in the mandibular denture.

A preferable method, however, is the complete closure of the maxillary spaces by the distal movement of the cuspids and the lingual movement of the incisors, maintaining the maxillary molars and premolars as stationary as possible. These posterior teeth may be held in position either by the use of occipital anchorage or by the insertion of an acrylic denture. In this way the incline plane relationships of the posterior teeth are greatly improved not so much by the added distal movement of the maxillary teeth as by the mesial movement of the mandibular molars and second bicuspids.

Some orthodontists, however, are of the opinion that the Class II molar relationship should be corrected, or somewhat overcorrected, before the extractions are carried out. This method would entail the building up of a dynamic stationary anchorage in the mandible prior to the use of Class II elastics, thus prolonging the length of treatment to the extent of approximately three months. The use of the Brodie type of mandibular anchorage might be a useful adjunct in this technique as no anchorage "build-up" is required, and if any mesial migration of the mandibular denture should occur it will be overcome by the extraction of teeth at a later date.

Treatment of Class III Cases.

The extraction of teeth in Class III cases is usually limited to the mandibular incisor region. This is due to the fact that the mandibular incisors are usually overlying basal bone and in lingual axial inclination, while the bone covering the lingual surface of their roots is extremely thin. Hence, any great degree of lingual movement of the four mandibular incisor teeth, made necessary by the extraction of the two first bicuspids, is apt to be accompanied by tissue destruction at the lingual gingival margin.

Extraction of First Permanent Molars in Class I & Class II Cases.

The extraction of the four first permanent molar teeth is by no means an uncommon procedure in these cases. The treatment, under these conditions, consists of the distal movement of the maxillary posterior segments carried out through the medium of Class II elastics and distal tipping bends. These bends are incorporated in an .021" x .025" maxillary arch, which extends as far distally as the second bicuspids on either side, the maxillary second permanent molars being left out of the "set up" until the distal movement is complete.

The alignment of the mandibular incisors and bicuspids is brought about solely by the ligation of the continuous archwires, if the malocclusion is not too excessive, or by the use of distal tipping bends and extra-oral anchorage. The mesial migration of the mandibular second molars is accomplished, to a large extent, through the medium of the Class II elastics.

Conclusion.

This lecture has shown that much thought has been given by practising orthodontists to the design and elaboration of fixed orthodontic appliances. It might be asked have we reached the peak of their complexity? Would further research along these lines be to our advantage? Or should our talents be directed rather towards a simplicity of apparatus, to the benefit of both patient and operator?

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Practical Methods of Caries Control*

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INTRODUCTION:

Recent research concerning the problem of dental caries control and of the process of the disease itself has progressed into ever narrowing and more speculative channels, and the assessment and application of this new knowledge is a task for which the busy dental practitioner has little facilities or time to undertake.

It is from this point of view that this paper has been written, to outline the basis and assess the efficacy of measures for dental caries control, which have been recently developed.

These will be dealt with in three sections:

A. Fluorides.

B. Carbohydrate reduction plans.

C. Ammonium compounds in mouthwashes and dentifrices.

A. FLUORIDES:

(1) *Artificial fluoridation.*

During the last ten years or so an ever increasing body of evidence has been accumulating, to show that there is a relationship between the fluoride content of drinking water and the dental caries experience of persons who use this water continuously during the developmental period of the teeth and that, furthermore, this relationship is an inverse one, the dental caries experience decreasing as the fluoride concentration of the water increases. The fluoride-caries hypothesis has received support from epidemiological investigations all over the world[1-5]. In Australia, where there are extensive fluoride-containing bore waters, particularly in Queensland, there has also been reported a lowered incidence of caries in the persons who use fluoride waters than individuals who use fluoride-free waters.[6]

In the United States of America, the Public Health Service has conducted a most thorough series of epidemiological studies in carefully selected population groups. In order to ensure that, as far as possible, the only varying environmental factor was the fluoride content of the water supply, the children selected had to have been continuously exposed to the water for the first eight years of life. The 12-14 year age group was selected, as most of the permanent teeth are present at this age. White children only were examined to exclude racial caries differences, and such factors as the number of hours of sunlight and the foods eaten and the amount of dental care of the children were all taken into consideration.

The most recent report[7] of these epidemiological investigations show that 8,576 children in twenty-seven cities in eight states have been examined and the dental caries experience related to the fluoride exposure and dental fluorosis. (Table I.)

It can be seen from the table that increasing the fluoride content above 1.0 p.p.m. produces little lowering of caries incidence, but it does increase the degree of dental fluorosis.

From a public health point of view this finding is most important because it shows that the immunity to caries produced by fluoride occurs at a level (1.0 p.p.m.) of fluoride in water which does not produce any notable degree of dental fluorosis.[8]†

This evidence suggests a practical measure for the partial control of dental caries by the fluorination of domestic water supplies. In a previous paper[9] the public health aspects of water fluorination were discussed and it was shown that both experimental and epidemiological investigations indicate that at low levels of fluorine intake (below 4.5 mgs. per day), the greater part of the fluorine is excreted in the urine, and below 3 mgs. per day, no measurable storage occurred, and thus no cumulative toxicosis would result. Furthermore, it was pointed out, as had been done by Dean[10], that many hundreds of thousands of people in the United States of America had used high fluoride waters (over 1.0 p.p.m.) for up to sixty years and had shown as a result only a very desirable decrease in dental caries experience.

Accordingly, in the United States and in Canada experimental studies have been established in the artificial fluoridation‡ of public water supplies, to determine whether fluorides added artificially to water would produce the same effects as those which occur natural'y in water. McClure[11] has shown by metabolism

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*Read at the 12th Australian Dental Congress, Sydney, August, 1950.

†At a level of 1.0 p.p.m. (F) in water, 10% of population using the water have white spots on the teeth.

‡The term "fluoridation" is to be preferred to "fluorination" as the former connotes the addition of a fluoride to a water, while the latter signifies the addition of fluorine. Analogously, the term chlorination refers to the addition of the gas chlorine directly to the water.

TABLE I.

Summary of dental caries and fluorosis findings in 8,576 selected white school children 12-14 years of age in twenty-seven cities of eight states in relation to fluoride.

City	Children examined	Clinical			Water supply
		Caries experience in permanent teeth		Per cent. children with fluorosis	Fluoride, p.p.m.
		Per cent. with none	Number per 100 children		
Hereford, Texas	60	38.3	147	100.0	3.1
Colorado Springs, Colo.	404	28.5	246	73.8	2.6
Galesburg, Ill.	273	27.8	236	47.6	1.9
Elmhurst, Ill.	170	25.3	252	40.0	1.8
Maywood, Ill.	171	29.8	258	33.3	1.2*
East Moline, Ill.	152	20.4	303	31.6	1.2*
Joliet, Ill.	447	18.3	323	25.3	1.3
Aurora, Ill....	633	23.5	281	15.0	1.2
Kewanee, Ill.	123	17.9	343	12.2	0.9
Vicksburg, Miss.	172	8.7	587	11.0	0.2
Nashville, Tenn.	662	9.4	461	8.6	0.0
Clarksville, Tenn.	60	16.7	458	8.3	0.2
Pueblo, Colo.	614	10.6	412	6.5	0.6
Marion, Ohio	263	5.7	556	6.1	0.4
Elgin, Ill.	403	11.4	444	4.2	0.5
Lima, Ohio	454	2.2	652	2.2	0.3
Evanston, Ill.	256	3.9	673	1.6	0.0
Zanesville, Ohio	459	2.6	733	1.5	0.2
Escanaba, Mich.	270	1.1	877	1.5	0.2
Portsmouth, Ohio	469	1.3	772	1.3	0.1
Middletown, Ohio	370	1.9	703	1.1	0.2
Oak Park	329	4.3	722	0.6	0.0
Elkhart, Ind.	278	1.4	823	0.4	0.1
Quincy, Ill.	330	2.4	706	0.3	0.1
Waukegan, Ill.	423	3.1	810	0.2	0.0
Michigan City, Ind.	236	0.0	1,037	0.0	0.1
Key West, Fla.	95	0.0	1,070	0.0	0.1**

*There is both presumptive and direct evidence that these water supplies contained about 1.5 p.p.m. of fluoride prior to a few years ago.

**Average of five water samples from cisterns considered typical of those used by most Key West inhabitants.

studies that fluoride added to drinking water is excreted in the same manner as that which naturally occurs in water and he concludes that "a domestic water supply to which sodium fluoride is added to give a fluorine content of 1.0 p.p.m. or less fluorine would not appear to create a public health hazard of cumulative toxic fluorosis." Thus, laboratory evidence indicates that fluorides either natural or artificial have the same effects, but added to both the evidence of laboratory research and animal experimentation, progress reports from areas where artificial fluoridation has been introduced, indicates that there has been a marked lowering of dental caries experience and also a decrease in the *Lactobacillus acidophilus* content of the saliva[12]. Some of the experimental projects have now been in progress five years, and although the projects are planned for a 12-15 year period, this lowering of dental caries rate may be taken as an indication of the effectiveness of this method of caries control.

In 1947, there were six fluoridation projects in progress in North America and five expected to commence as soon as equipment had been installed.[9] In June, 1949, Bull[13] reported that in Wisconsin alone there were five cities fluoridating their water supplies and twenty-three more cities installing equipment to do so.

The results of water fluoridation at Sheboygan, Wisconsin, have been reported by Bull[13] for the first three year period of the project, and the effect of the fluoride on the younger children, 5-6 year group, is most marked. In this group the D.E.F. teeth (Decayed, Extracted or Filled), per child have decreased from 4.8 to 3.4, a decrease of 28%. The D.M.F. teeth (Decay, Missing or Filled), in the 9 year group have decreased from 3.03 to 2.46, a decrease of 18%, and in the 12-14 year group, the D.M.F. teeth have decreased

from 8.54 to 6.92, a decrease of 19%. Reports from other areas also show that there is a downward trend in dental caries experience after artificial fluoridation.

Taylor[14] in 1949, has reported, after a twenty-nine month period of fluoridation, a 23% reduction in decay rates of permanent teeth in children at Marshall, Texas, and a 47% reduction in caries rate (D.E.F. teeth) of the deciduous teeth. From Brantford, Ontario, there has been reported a 45% decrease in the decay rates of deciduous teeth and a 22% decrease in permanent teeth decay rates after three and one half years of fluoridation[15].

At Newburgh, New York, where water fluoridation was commenced in June, 1944, the greatest benefit conferred by the fluoride is to the younger age groups (deciduous teeth) due to the fact that the fluoride is ingested during the period of formation of the teeth, but Ast *et al.*[16] state, "The D.M.F. rate for permanent teeth shows a consistent downward trend in Newburgh, from 21.0 to 14.8 per 100 permanent teeth." This is a reduction of 30% in the rates of decay for permanent teeth.

It is apparent even at this stage that if these present trends, i.e., the lowering of the dental caries experience of persons using artificially fluoridated water continue, then a practical and economical measure for the partial control of dental caries has been found. A consideration of the natural fluoride balance which exists in the body when the level of fluoride intake is low (up to 3 milligrams of fluoride per day) will show that there is no danger of a cumulative toxicosis resulting from storage of excess fluoride in the skeletal tissues[9].

On June 22, 1950, the United States Public Health Service issued the following statement:

> "Preliminary data suggest a lowered amount of dental caries following fluoridation of a public water supply. Although evidence is rapidly accumulating, the controlled studies now being carried on should be continued and others as may be necessary inaugurated.
>
> "In order to utilize this preventive at the earliest possible moment, formulation of plans for fluoridation of public water supplies as a procedure for the partial control of dental caries may be encouraged, subject to the approval of the State and Local Health Authorities"[17].

From an engineering aspect there are no difficulties regarding the addition of fluoride to a water supply of any size. The cost of such a project is about 10 cents per person a year, but with the introduction of sodium silico fluoride to be used instead of sodium fluoride the cost will be much less[15].

Water fluoridation must not become a health measure that is withheld from the community because of unwarranted professional scepticism, held in spite of a great bulk of reliable experimental and epidemiological evidence.

(2) *Topical application of fluorides.*

After the epidemiological evidence of the fluoride-caries relationship was established, studies in the nature of the mechanism of the inhibitory effect of fluoride on caries showed as a result of animal and laboratory experiments that the effect could be due to an increased fluoride content of the enamel.

When enamel was exposed to solutions of fluoride salts it absorbed fluoride and acquired both anti-enzymatic activity and increased resistance to acid action. As a result of these findings series of experiments in topical application of fluorides to the teeth were begun, the first using large groups being that of Knutson and Armstrong[18] in 1942, which was continued for three years.

A consistent reduction, averaging 40%, was shown each year in the incidence of caries in those teeth which were treated by fluoride[19].

The widespread nature and intensity of these studies is illustrated by the statement of Kroschel[20].

> "After more than eight years' research with more than 15,000 children in various sections of the United States it became increasingly apparent that topical applications of a 2% sodium fluoride solution to the teeth of children are a practical and effective method for reducing the incidence of dental caries."

Although the mechanism of this inhibitory action of fluorides on dental caries has not been fully elucidated, the enamel after treatment with fluoride acquires a hardness, an acid resistance, and an anti-bacterial property which it did not possess previously.

Phillips and Swartz[21] have recently pointed out that enough of the mechanism is known to make topical application of fluoride a standard procedure in preventive dentistry.

> "The effectiveness of fluoride compounds in reducing enamel solubility and inhibiting dental caries has been so well established that the topical application of sodium fluoride is now an everyday procedure in the dental office."

At the present time the most acceptable technique for the application of sodium fluoride solution is that described by Knutson[22]. The

initial prophylaxis is a most important step as the efficacy of the procedure is halved if this be omitted.

Technique of application of solution:

1. Prophylaxis. "The first step in the topical application of sodium fluoride described here consists of a thorough cleansing of the coronal surfaces of the teeth. Only the first in the series of four applications is preceded by dental prophylaxis."

2. Isolate the teeth with cotton rolls. "The cleansed teeth are blocked off or isolated with No. 2 cotton rolls. When the cotton rolls are positioned properly they are clear of the teeth so they do not absorb the applied solution."

3. Dry the surfaces to be treated. "After the teeth have been isolated with cotton rolls they are dried with compressed air."

4. Application of solution. "The fourth step in the procedure consists of applying a 2 per cent. solution of sodium fluoride (C. P. sodium fluoride in distilled water) to the dried enamel surfaces of the teeth. A cotton applicator may be used. When the solution is applied properly it visibly wets all surfaces, including the interproximal surfaces. The applied solution is permitted to dry in air for approximately three minutes. On completion of the procedure, the mouth may be rinsed with water." However, rinsing with water is not an essential or important part of the procedure and may be dispensed with if desired.

The second, third and fourth applications of the solution of sodium fluoride are made at intervals of approximately one week.

Knutson has suggested that these treatments be given at the ages of three, seven, ten and thirteen as the prophylactic effect of the fluoride will last during the subsequent three-year period.

B. Carbohydrate-Reduction Plans:

The control of rampant dental caries is an individual problem, as distinct from the previously suggested mass control method of water fluoridation, and it is, accordingly, made difficult by the fact that the individual personally has to co-operate actively and extensively in this programme.

For this reason it is only practicable to use this method of carbohydrate restriction in cases of rampant caries where the patient runs the risk of losing all the natural teeth, not in a patient who develops one to two newly carious tooth surfaces per year. This, of course, does not mean that carbohydrates should not be restricted by all caries-susceptible persons but not so completely, nor associated with salivary lactobacillus counts, as is recommended in the periodic restriction of carbohydrate for the control of dental caries.

This method of caries control is based on the clinical observations that in caries-active patients the *L. acidophilus* index is high and the sugar consumption is likewise high and that, following the reduction of the refined carbohydrate in the diet, there is a lowering of the lactobacillus index and a decrease in dental caries frequency.

There are several methods for reducing the carbohydrate intake and one has been devised by Jay[23]. This consists of a series of diet plans in which the carbohydrate content of the diet is initially reduced to below 100 grams per day by the elimination of sugar, bread, potatoes and the higher carbohydrate fruit and vegetables for a two-week period. At the end of each dietary period, a lactobacillus count is made and the patient instructed to change to the succeeding diet plan. The careful following of the diet plans in nearly all cases leads to a very marked decrease in the lactobacillus count. After this period, whole meal bread to the extent of six slices per day, fruit and vegetables, including potatoes, are introduced in desirable amounts, but no sugar is included in the diet either free or in food preparation at this stage. During the third period the plan of the second period is continued but sugar is introduced at one meal per day (about one teaspoonful).

If the lactobacillus count does not increase after two weeks on diet plan "three" then the diet is unrestricted. Jay[23] reported that in a group of 809 cases, 83.4% show marked reduction in lactobacillus counts after completing diet plan "one" and that 75-80% of cases, after the completion of the entire plan, can maintain low lactobacillus counts on an unrestricted diet.

Becks[24] reports similar results from a programme of carbohydrate restriction, for in a group of 665 co-operative patients, a reduction in oral lactobacilli and a decrease in caries incidence occurred in 88.4% of cases.

In the dietary plan suggested by Becks, however, carbohydrate is not so drastically reduced as in Jay's procedure, the patients being impressed with the necessity of eliminating "all excessive refined sugars and refined flour products"[24]. Fresh fruit was to be consumed only once daily and at breakfast time. The calorific requirement of the dietary was supplied by protein and other foods of low or negligible carbohydrate content.

Becks emphasises that this method of caries control is completely practical, but that personal contact and explanation to the patient of the procedure are necessary to obtain

satisfactory co-operation and that the plan when followed closely resulted in a drastic decrease in the lactobacillus index and, subsequently, a decrease in the amount of newly carious tooth surfaces.

Following the plan of Jay, Kitchin and Permar[25] found that oral lactobacilli were able to be reduced by carbohydrate restriction in a series of 559 cases which they investigated over a three year period.

The majority of the patients referred to in the report of Kitchin and Permar were the patients of private dentists. Laboratory reports were sent to the dentists and the diet plans were transmitted through the dentists. The fact that the dietary control was effective in these circumstances indicate that this method is a practical and efficacious measure for the control of rampant dental caries.

C. Ammonium Compounds in Mouthwashes and Dentifrices:

Although the ammonia content of the saliva has been investigated for many years and its possible caries-inhibitory action as a buffer or inhibitor of acid formation by bacteria suggested, it is only during recent years that an apparently specific inhibitory action of ammonia on the *L. acidophilus* has been brought forward as an alternative mechanism whereby ammonia may influence caries susceptibility.

The use of ammonium compounds in dentifrices and mouth rinses is correspondingly based on either of these mechanisms.

In 1934, Grove and Grove[26] suggested the use of a mouth rinse of ammonium hydroxide to be used to reduce caries susceptibility because they believed that there was a greater concentration of ammonia in the saliva of the caries-immune person.

It was not until 1943, however, that Stephan[27] showed that concentrations of urea from 40% to 50% applied to mucinous plaques would markedly inhibit acid production and the pH drop produced by a glucose mouth rinse. This effect of urea may be threefold: (i) The enzyme urease converts the urea to ammonium carborate which neutralises acid produced, (ii) urea inhibits glycolysis, (iii) urea denatures protein and may have a direct effect on bacteria and mucin.

In 1949, Henschel and Lieber[28] reported the results of a clinical trial of a high urea (22½%) dentifrice on a group of 100 patients and they observed a reduction of 37.5% in new carious tooth surfaces over a two year period. The authors themselves are in doubt as to whether the dentifrice caused the reduction in caries, or whether it was "enthusiastic oral hygiene" which will of its own accord materially reduce caries incidence.

A different application of urea is in the detergent urea mouthwash advocated by Goodfriend[29]. The composition of the mouthwash is "40 grams sodium alkyl arylsulfonate, 80 grams urea, 1 drachm of flavouring and 1 grain of colour to 1 gallon of pure water."

Over an eight year period on a group of 186, patients who were being treated for bite abnormalities showed a reduction in caries incidence of 75% as compared with a similar group of patients in the previous eight year period.

The detergent is combined with the urea in order to reduce the surface tension of the solution and allow it to impregnate the plaques and other fermentable debris on the teeth.

It is very likely that the regular use of a detergent mouthwash would constitute good oral hygiene, even apart from the possible therapeutic effects of the urea, and reduce the incidence of dental caries, but there have been to date no other clinical trials which confirm these findings.

The investigations which appear to give support to the hypothesis that ammonia will decrease caries susceptibility is the work of Kesel[30] who found that the saliva of caries-immune persons developed after incubation for seven days a maximum inhibitory effect on *Lactobacillus acidophilus*. This inhibitory factor was found to be ammonia, and when ammonium compounds were added to the bacterial cultures they produced the same degree of inhibition as the naturally-formed inhibitory factor.

The first dentifrice contained only dibasic ammonium phosphate and in a clinical trial on a small group of subjects resulted in a decrease in lactobacillus counts.

In order to prevent glycolysis, urea was added to the dibasic ammonium phosphate, and it was found experimentally that urea and dibasic ammonium phosphate had a synergystic effect which was much more marked than that possessed by either substance alone.

Thus the ammonium ion toothpowder containing 5% dibasic ammonium phosphate and 3% urea originated. In a limited clinical trial on a group of 55 patients (10 patients being a control group), after two years there were 33 patients remaining, 19 of the group had developed no new caries and 14 developed an average of 1.5 new carious surfaces. No conclusions can be drawn from this survey because of its size and lack of adequate controls as Kesel[30] admits. A further investigation is planned to test the efficacy of this ammonium urea dentifrice. It would appear from the initial clinical investigation that there is lacking a clinical effect on the dental caries proportional to the efficacy of the *in vitro* studies on the inhibition of the *L.*

acidophilus. However, the ultimate criterion of caries control measure, as far as usefulness is concerned, is its clinical effect: the experimental verification of the hypothesis *in vivo*.

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Xylocaine for Local Anaesthesia*

B. G. Broadbent, M.D.S.

Xylocaine, a local anaesthetic drug, was synthesised in Sweden by Lofgren and Lundquist in 1943. Its synthesis was the result of investigation on acetanilide derivatives by Lofgren and Erdtman in 1937. During the period 1944-1947 the drug was clinically tested by Gordh, Goldberg and others in Sweden.

The two discoverers named the substance "Lidocaine hydrochloride." The formula is

$$\begin{array}{l} CH_3 \\ \bigcirc - NH-CO-CH_2-N(C_2H_5)_2\ HCl \\ CH_3 \end{array}$$

and can be called either di ethyl amino acet 2.6 xylide hydrochloride or ω diethyl amino 2.6 dimethyl acetanilide hydrochloride.

I imagine the xylocaine which is its registered brand name came from the xylide grouping. The manufacturers would not wish for any association in name with acetanilide and its dangerous cumulative side effects in gastric disorders, anaemia and so on. Doubleday[1] in England has said that the two methyl groupings stabilise the acetanilide quite effectively and its behaviour seems to confirm this.

Xylocaine is quite different to novocaine hydrochloride $NH_2 - \bigcirc - COO=CH_2-CH_2=N(CH_2H_5)$. HCl—namely para amino benzoyl di ethyl amino-ethanol hydrochloride. It can be seen that there is no para-amino benzoyl grouping or benzoic acid derivatives. Thus it, like nupercaine, does not fall into the usual classification of local anaesthetics of:—

(A) Benzoic acid derivatives, e.g., cocaine and metycaine.

*Condensed from Lecture at Armidale Dental Convention, August, 1951.

(B) Para-amino benzoic acid derivatives, e.g., novocaine, monocaine, pontocaine and butyn.

Because xylocaine is not a group B type it is not prone to the faults these drugs are heir to, such as allergies, dermatitis and the systemic anti-sulphonamide reaction.

Charter *et al.*[2] have shown that at least 3% of dentists are subject to some form of novocaine sensitivity, usually a dermatitis, and unfortunately cases have frequently been reported of this with all of the Group B anaesthetics. I have found no reported cases of allergy or dermatitis to xylocaine yet and Gruber[3] states that 90% of Swedish dentists use this in preference to novocaine in general practice.

GENERAL QUALITIES.

Stability: Xylocaine is more stable in aequeous solutions than any other local anaesthetic including pontocaine. It can be autoclaved or boiled in acid or alkaline solutions. Any instability comes from the associated adrenaline, which breaks down on boiling and is unstable in solutions of higher pH than 4.0.

Tissue irritation: This is claimed to be less with xylocaine than with novocaine of the same pH. Up to 8% has been used topically in eyes without irritation. No clinical signs of tissue irritation were observed.

Hydrogen ion concentration: The pH of 2% xylocaine hydrochloride (aequeous) is 6.9. The manufacturers claim a stable pH with adrenaline of 3.5 to 4.0. This appears rather acid but is non-irritant clinically. An American check of stock cartridge solutions[4] shows that most fresh stock have a pH below 6.0, with the older solutions gradually falling to a pH of 4.0, if there is a content of adrenaline and sodium bisulphite.

With adrenaline: Like cocaine, xylocaine is a slight vaso-constrictor whereas most local anaesthetics are dilators. It is quite compatible with adrenaline, though it can be used without. Seldom is there dental use for a stronger concentration than 1—50,000 adrenaline which produces a very good haemostasis and a prolonged duration. For general purposes 1—80,000 or 1—100,000 adrenaline seems indicated. Bjorn and Huldt[5] found, without adrenaline, 70% success by local infiltration in dentistry, compared with nil success with 2% novocaine alone. However, the anaesthesia was of short duration but eliminated the use of adrenaline in some cases of diabetes, thyrotoxicosis and hypertension.

Uses: Xylocaine has been employed by spinal, caudal, peridural routes by local infiltration, regional blocks, topically and intravenously as an analgesic. Topically it is a strong anaesthetic. Urologists have had good success with 2% solutions. A maximum effect is achieved in 5 minutes. Experiments are in progress for its topical use in the mouth as a 5% paste in certain carbowaxes.

Toxicity: The maximum dose suggested is, as for novocaine, 0.5 gm. in 24 hours or 25 ccs. of 2% which would be hard to use in dentistry. The toxicity in mice was found to be equal to novocaine in 0.5% solutions but rising to 50% more toxic in 2%. All observers indicate an extremely low incidence of toxic side effects. When they did occur, they consisted of muscle twitches leading to convulsions, dizziness, tremors, nausea and vomiting.

I found none so severe and few dental observers have. So far as can be ascertained only one fatality has been reported in which the patient was a shocked, aged, syphilitic with aortic insufficiency and a strangulated hernia who had an overdose in a caudal block. Death followed after brief convulsions. Volume for volume there is a slightly higher toxicity than novocaine, but since approximately only half the volume is required with xylocaine for the same task the relative toxicity is less.

The New and Non-Official Remedies 1950 states, "Injection of xylocaine produces more prompt, intense and extensive anaesthesia than in equal concentrations of procaine. Systemic side reactions and local irritant effects are rare. Xylocaine provided adequate anaesthesia with less fall in blood pressure than occurs with better known agents . . .

". . . Solutions of half strength of those used in procaine should provide equivalent anaesthetic potency."

Potency, quality, spread and onset: Xylocaine 2% has been classed as similar in depth to 2% metycaine or 4% novocaine and has been regarded as more specific for sensory and para-sympathetic nerves without such a degree of motor involvement. In the author's experience it seems considerably stronger than 1% cocaine. There is a readily recognisable increase in depth and intensity of anaesthesia than with novocaine and a more rapid onset than with any other local anaesthesia drug used in dentistry. The ready penetration of bone, great spread especially in soft tissues, speed and intensity of anaesthesia is diagnostic in any comparative "blind" test of anaesthetic solutions.

Duration: This is dependent on the vaso-constrictor content but with 2% and 1—80,000 adrenaline compared with 2% novocaine with 1—50,000 adrenaline in infiltration it is generally ½ hour longer and 1 hour in regional uses. Some patients remark on the absence of a lingering paraesthesia as the anaesthesia wears off.

Observations.

A series of approximately 300 patients were treated with 2% xylocaine 1—80,000 adrenaline in private practice and case histories were taken. The patients were chosen for (1) their known history of toxic reactions to local anaesthesia; (2) comparison of purposes for volume, onset, intensity or spread of anaesthesia; (3) speed of pulpal anaesthesia or minimum tissue oedema; (4) an analysis of intelligent patients' subjective feelings. The cases included 60 mandibular blocks, 10 maxillary blocks, 30 intra-osseous injections, 12 planned surgical operations, 6 immediate denture insertions, 5 acute abcesses, several very old and very young patients, and the volumes injected varied from ½ to 10 ccs.

I had five failures, viz., (a) a maxillary block where I could not reach the pterygo-palatine fossa; (b) a mandibular block 4 ccs. failed to achieve pulpal anaesthesia in |7; (c) incomplete pulpal anaesthesia in |1 after ¼ cc. labial infiltration; (d) incomplete after 2 ccs. buccal infiltration for |6 of a large nervous woman with a heavy zygoma; (e) 2 ccs. mandibular block for extraction of 4| which required a further 2 ccs. intra-osseously for success.

Post-operative troubles were basically nil. Six patients mentioned slight soreness and there were no post-operative oedemas attributable to anaeshetic solution.

Objective symptoms were rare and consisted of slight rises in pulse or respiratory rates or fullness, slight sweating along the upper lip, slight to considerable loss of colour and no tremors or twitches.

Subjective symptoms were conspicuous by their absence and this was often remarked on by the patient. There was none of the fidgetiness, garrulousness or anxiety state associated with cocaine. Patients remarks included, "lasts too long"—"too intense"—"spreads too far"—"less depressed"—"no all-over weakness"—"goes quickly once it starts."

Factors in Local Infiltration.

1. Use half the usual novocaine volume.
2. Soft tissue anaesthesia could in operative work be classed as too intense.
3. The spread of pulpal anaesthesia to adjoining teeth is very great, e.g., 1 cc. labial infiltration for pulpal anaesthesia of maxillary central lateral and cuspid and sometimes first bicuspid.
4. Onset is almost akin to intra-osseous anaesthesia.
5. Excellent in acute abscess conditions because of less bulk and spread of effect.

Factors in Regional Uses.

1. Use half accustomed volume of novocaine.
2. Onset time is halved—pulpal anaesthesia occurring between 45 seconds and 7 minutes.
3. A significantly greater occurrence of extensive pulpal anaesthesia than with novocaine, especially in the lower incisors and bicuspids and in the supersensitive cervical areas.

Intra-osseous Use.

2% xylocaine was found to be approximately equivalent to 1% cocaine with 1—100,000 adrenaline in onset, depth, spread and volumes of anaesthesia but with far less toxic side effects and a greater tendency (unfortunate in operative work) to spread into soft tissue.

Conclusion.

In the author's opinion xylocaine is preferable in general dental practice to any of the previous types of anaesthetic solutions. The advantages are:—

1. Greater stability and can be autoclaved.
2. Greater potency.
3. Quicker onset and greater spread.
4. Longer duration. (Possible disadvantage in some cases.)
5. Is a slight vaso-constrictor and needs less adrenaline or can be used without any.
6. A good topical anaesthetic.
7. Absence of toxic side effects.
8. No reported allergies.
9. No anti-sulphonamide reaction.

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Prevention—Patient, Dentist, Toothbrush

Dental Health Education Department

No dentist or patient can deny in the face of clinical evidence the prevalence of gingival and periodontal disorders, and the inevitable result of the neglect of early signs and symptons. Patients must realize that for the dentist to put in hours of work repairing tooth structure and restoring function to the jaws is waste of man-hours and money, if the patient is not going to co-operate in the after care of the mouth.

Here we come to the real field of prevention, and the dentist with his training is best fitted to teach the fundamentals of dental care; too many dentists are apt to forget that their profession expects of them teaching as well as treatment. If every dentist gave half an hour of his time per day, in three-minute talks to ten adult patients, instead of the usual conversation on sport, politics or the weather, we would reach an audience that would make any propagandist's mouth water.

There is no need and, in fact, no point in being too technical: the important part that each particular tooth plays in the dental arch as a whole, and why it is important that they be preserved or restored, can be explained to the patients in a few sentences, with their own mouth as an illustration or model.

Patients can be grouped roughly into two sections: (1) those who take an interest in the preservation of their teeth for varied reasons (health, appearance, comfort, etc.); (2) those who just couldn't care less. Both should be a spur to the dentist, one to assist, the other to convert.

For too long has the dental profession passed on to the advertisers of toothpastes the job of teaching the simple rudiments of dental health. Much has been brought forward in these last few years on the importance of this or that paste, powder or toothbrush, but the one basic factor that stands out from all these claims is that the toothbrush, properly used, will prevent at least 60% of tooth decay and gingival disorders.

A technique that will clean the teeth and massage the gums, without injury, in the least possible time is a good one. If a dentist will work out a successful method in his own mouth, that is the method he should teach; no one can teach successfully something in which he does not wholeheartedly believe: that essential of all teaching—sincerity—will be lacking.

Let a patient clean his own teeth before you, then, with a hand mirror and probe, point out in the mouth exactly where the cleaning was at fault—a probe full of debris speaks louder than words.

Then, while the patient watches, demonstrate your method that will clean every cleanable surface of every tooth and massage the gums at the same time.

Finally, impress on the patients that they should clean their teeth for the same reason that they wash their hands or the eating utensils because they are dirty: eating makes them dirty so, logically, teeth should be cleaned after eating.

Dental Materials

*Current Notes (No. 9)**

TUNGSTEN CARBIDE BURS.

The results of investigations on the use of tungsten carbide burs carried out at the Prosthetic Department of the Birmingham University are being published in a series of articles. The authors[1] consider the manufacture of this type of dental bur of major importance to the profession in that it will lead to "considerable advances in the technique of cavity preparation in terms of speed of working, efficiency of cutting and, most important of all, an appreciable reduction in pain and unfavourable pulp reactions."

The first paper contains an interesting general history of the development of burs followed by an account of the special nature of tungsten carbide and the designs of cutting head required as a consequence. A brief clinical report summarising the findings of a number of general practitioners indicated that in cutting efficiency tunsten carbide burs were "incomparably superior to steel" although estimates of the relative life varied greatly. Opinion was divided as to the vibration pro-

*Contribution from the Commonwealth Bureau of Dental Standards.

duced by the burs, but it was pointed out that in practice tungsten carbide tools are used at considerably higher speeds than steel tools. If this is applied to dental burs less vibration will result.

Carefully conducted laboratory tests by one of the authors[2] confirmed that the heat produced in cutting a unit amount of enamel was much less in the case of tungsten carbide burs. The blades of the steel burs become badly mutilated in the first half-minute of cutting enamel, greatly reducing their efficiency. On the basis of the particular burs used he concluded: "The tungsten carbide bur cut faster, lasted longer, and produced less heat per unit mass of enamel cut than the steel bur."

Tungsten carbide burs have several disadvantages, the chief one being in their cost which is much higher than that of steel burs. In order to distinguish them from steel burs and so avoid the risk of discarding them by mistake an English manufacturer supplies tungsten carbide burs with gold coloured mandrels. Another disadvantage, particularly in the burs as first marketed, was the fairly frequent breaking off of the tungsten carbide head from the steel mandrel. The brazing of tungsten carbide to steel is not a simple process but there is evidence that this is now being perfected. Unfortunately the tungsten carbide itself is very brittle and blades of the material tend to chip or break off in time. In some instances this does not seriously affect the cutting performance of the burs as remaining edges retain their sharpness, but vibration will be increased.

The problems associated with the joining of tungsten carbide heads to steel and their grinding on such a small scale are considerable and it is gratifying to see that good progress is being made as a result of close co-operation between members of the engineering and dental professions.

Silicate Cements.

The disabilities of silicate cements for anterior restorations are well-known and Manly and others[3] have made a valiant attempt to improve their properties by varying the composition of the liquid and powder. In the past, much of the fundamental work on silicate cements has been carried out industrially without publication, so their results will clear the air somewhat, in spite of the conclusion "no composition was found which was appreciably superior in properties to representative commercial products."

It therefore appears unlikely that there will be any reprieve for silicate cements in the face of competition from the development of self-hardening acrylic resins for anterior restorations.

The effect of loss or gain of water by the cement liquid on the properties of dental cement is familiar. A recent report[4] on the deterioration of silicate cements in the tropics showed that in the high temperatures reached under certain storage conditions, loss of water by evaporation from the bottles causes delayed setting of the mixed cements. The normal setting rate could be restored by the addition of the appropriate quantity of distilled water. It was concluded that either more efficient containers or facilities for transport should be designed for silicate cements intended for tropical use.

In maintaining the water balance in the cement liquid during clinical use in the tropics the authors found that the use of a floating film of light mineral oil was the most adaptable. In this way evaporation or gain of moisture is retarded although not completely prevented. Care must be taken in any climate, humid or dry, to preserve the concentration of the cement liquid which has been adjusted by the manufacturer to give optimum results. For most Australian conditions keeping the bottles well stoppered when not in use and making a practice of discarding the last 20 per cent. or so of the liquid should suffice.

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The DENTAL JOURNAL of AUSTRALIA

Editorial Department

The Public Dental Health

Because of the widespread and serious nature of dental disease, its eradication is important in the promotion of the general health of the community.

This problem has become so acute that in many countries schemes of national health insurance have been advocated and instituted to carry out dental services, particularly for children. The factors which contribute to the difficulty of the position are the shortage of trained personnel and the high incidence of dental disease. Furthermore, the position is aggravated by the increase in the ratio of population to dental graduates combined with the decline in the admissions to dental schools at least in the United States[1] and the increasing incidence of dental caries[2].

In New Zealand the solution of the problem was thought to be found in a dental programme conducted by the Public Health Department which operates by entrusting the greater part of the dental care of children to dental hygienists, who have had a two-year training course.

This scheme of delegating to partly trained auxiliaries the operative dental care of children is not a method for the control of dental caries, because the prevalence of dental caries in New Zealand children is high although many carious lesions have been restored[3].

In Great Britain also it is now proposed to introduce into the National Health Scheme a similar system of dental auxiliaries trained to fill and extract teeth, this action being taken because of the shortage of personnel in the school dental service[4].

A pertinent comment on this question of auxiliaries in the dental health services was made by R. G. Ellis in his report to the Canadian Dental Association, when he said: "The dental profession in New Zealand (and Australia) is at this very moment reacting violently to the increasing pressure of the dental prosthetic technicians for recognition.

"The politician poses an embarrassing question when he asks, 'If operative technicians are acceptable for children, why not prosthetic technicians for adults?'"

The approach to the problem of raising the national standard of dental health is one of research, prevention and education rather than the introduction of sub-standard services.

At the last meeting of the Federation Dentaire Internationale in Brussels, June 9 to 17, a resolution suggesting this was passed by the Executive Council which urged that "all nations should utilize such preventive measures as the fluoridation of water supplies as a means of reducing the incidence of dental caries before undertaking programmes that would result in emphasis on restorative dentistry"[5].

The reduction in the prevalence of dental disease by the utilization of preventive and educational measures and research programmes will be conducive to the improvement of the standard of the public dental health

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News and Notes

University of Sydney

The Senate of the University of Sydney has decided to admit Mr. C. J. Griffin, B.D.S., to the degree of Doctor of Dental Science. Mr. Griffin submitted a thesis entitled "The Deflection of the Anterior Part of the Nasal Septum and Its Relation to Malposition of the Teeth" in support of his candidature for the Doctorate degree.

Mr. Griffin is to be congratulated on this achievement.

Professor A. J. Arnott, Dean of the Faculty of Dentistry, has been elected a Fellow of the Senate for two years from 1st January, 1952. This is a fitting tribute to the Dean in respect of his academic qualifications and the interest he takes in the Faculty of Dentistry and the University as a whole.

3rd Annual Berkshire Conference in Periodontology and Oral Pathology

The Division of Graduate and Post-Graduate Studies of Tufts College Dental School will conduct the Third Annual Berkshire Conference in Periodontology and Oral Pathology at Eastover, a resort hotel in Lenox, Massachusetts, June 15 to June 19, 1952. The conference will consist of four days of lectures, seminars, and panel discussions regarding clinical problems by outstanding teachers and clinicians in dentistry, medicine, and their related fields.

Further information may be obtained at the offices of the Association, 135 Macquarie Street, Sydney.

Opportunity for Practice

An opportunity exists for a resident dentist in the township of Eugowra. The dentist would serve the district of Eugowra, which includes Gooloogong, having a population of 3,000. Further details may be obtained from the Secretary, Eugowra District Chamber of Commerce, P.O. Box 36, Eugowra.

For Sale

Ideal residence and surgery available at Long Jetty for dentist. Unique opportunity in the large and growing district of Tuggerah Lakes. Ring Ent. 217. Bob Law, 522 Gosford Road, Long Jetty.

Cream reconditioned S.S. White unit with Ritter motor in first-class condition.

G. SAMUELS, FW 7843.

A.D.A.-B.M.A. Cricket Shield

The Annual Doctors vs. Dentists Cricket Match for the Shield has been set down for the Sydney Cricket Ground No. 2 on Wednesday, 12th March, 1952, at 10.30 a.m.

This match has been held over a number of years and has always proved a popular fixture.

Members are cordially invited to join the teams at afternoon tea, whilst those desirous of attending luncheon are asked to contact the Secretary.

Association Activities

Australian Dental Association
(NEW SOUTH WALES BRANCH)

OFFICE-BEARERS, 1951-52.

Dr. A. G. H. LAWES
President

Dr. F. E. HELMORE
Vice-President

Dr. A. G. ROWELL
Vice-President

Dr. E. H. BASTIAN
Honorary Treasurer

EXECUTIVE:

Edney, N. E.	Krauss, R.
Finnie, H. McD.	Leeder, R. G.
Fletcher, J. G.	Martin, N. D.
Gee, E. J.	Norton, R. Y.
Grainger, W. A.	Tompson, Ralph
Hunter, A. G.	Wilson, R. W.

Annie Praed Oration

The General Meeting of the Association for the month of October, 1951, was held in the Great Hall of the University of Sydney on Tuesday, 16th October, on which occasion the inaugural Annie Praed Oration was delivered.

Dr. E. R. Magnus, President, was in the Chair and there was a large attendance of members, distinguished visitors and guests, accompanied by ladies.

Following the entrance of the academic procession and its arrival on the dais, the President, Dr. Magnus, opened the meeting and conveyed apologies, amongst others, from the Chancellor, Deputy Chancellor and Vice-Chancellor of the University; the Federal Minister for Health and the State Minister for Health; the Presidents of the Royal Australasian Colleges of Physicians and Surgeons, the President of the Dental Board of New South Wales and the President of the United Dental Hospital of Sydney.

He formally welcomed, amongst others, Dr. J. V. Hall Best, President of the Australian Dental Association; Dr. A. J. Collins, President of the British Medical Association; Dr. R. H. McDonald, President-elect of the British Medical Association, New South Wales Branch; Professor Dew, Vice-President of the Royal Australasian College of Surgeons; Dr. Tebbutt, representing the Royal Australasian College of Physicians; Professor Carne, Dean of the Faculty of Veterinary Science; Sir Harry Moxham, Past President of the Australian Dental Association; W. H. Maze, Registrar of the University of Sydney; and Surgeon-Commander Richards, Lieutenant-Colonel Skinner and Squadron-Leader Clarke, representing the Services.

The President then formally introduced Professor A. J. Arnott, who proceeded to deliver the inaugural oration entitled "The Historical Development of Dentistry as a Profession in New South Wales."

Following the delivery of the Oration, Dr. J. V. Hall Best, President of the Australian Dental Association, expressed the appreciation of the meeting and of the Association for the excellence of the oration and congratulated the orator, Professor Arnott, upon the preparation and delivery of such an outstanding contribution to the history of dentistry in New South Wales.

The vote of thanks being carried by acclamation, the meeting terminated with the retirement of the academic procession at 10 p.m.

Annual General Meeting

Extract from the Minutes of the Annual General Meeting of the Association held in the Lecture Hall, B.M.A. House, 135-137 Macquarie Street, Sydney, on Tuesday, 27th November, 1951, at 8 p.m.

Present: Dr. E. R. Magnus, President, in the Chair, and an audience of 72 members and visitors.

Minutes: The Minutes of the Annual General Meeting held on 28th November, 1950, were read and signed as a correct record.

BUSINESS OF THE MEETING:

Report of the Executive for 1950-51:

The Annual Report of the Executive of the Association, having been circulated to all members, was before the Meeting. It was resolved that the Annual Report be received.

Balance Sheets, Supporting Accounts, Auditor's and Treasurer's Report:

Mr. F. R. Reid, Honorary Treasurer, referred members to the portion of the Annual Report dealing with Finance, and stated that the Balance Sheets and Supporting Accounts had been circulated to all members as part of the Annual Report. It was resolved that the Balance Sheets, Accounts and Auditor's Report for the year ending 30th September, 1951, be adopted.

Honorary Members for 1952:

It was resolved that the following persons be appointed honorary members of the Australian Dental Association, New South Wales Branch, for the year 1952:—

The President, Australian Dental Association; the President, British Dental Association; the President, American Dental Association; the President, New Zealand Dental Association; the President, British Medical Association (New South Wales Branch); Professor A. J. Arnott, Professor Harvey Sutton, Mrs. John Barr, B.D.S., Dr. P. C. Charlton, Dr. N. E. Goldsworthy, Professor R. Harris, Dr. E. R. Magnus, Dr. R. M. Cloutier.

Appointment of Auditors:

It was resolved that Messrs. Beck and Wayland be appointed Auditors for the ensuing financial year at a fee of seventy-five guineas.

Election of Executive for 1951-52:

The Secretary, as Returning Officer for the ballot for the Executive for the ensuing year, reported that the following members (set out in alphabetical order) had been elected to the Executive for the year:—

Dr. E. H. Bastian, Mr. N. E. Edney, Mr. H. McD. Finnie, Mr. J. G. Fletcher, Mr. E. J. Gee, Mr. W. A. Grainger, Dr. F. E. Helmore, Mr. A. G. Hunter, Mr. R. Krauss, Dr. A. G. H. Lawes, Mr. R. G. Leeder, Mr. N. D. Martin, Mr. R. Y. Norton, Dr. A. G. Rowell, Mr. R. Tompson, Mr. R. W. Wilson.

The President, Dr. Magnus, congratulated the newly-elected Executive and thanked the scrutineers for their assistance in the ballot.

The appreciation of the members of the Association was conveyed to the two members of the retiring Executive who had not sought re-election, viz., the President, Dr. E. R. Magnus, and the Honorary Treasurer, Mr. F. R. Reid. A motion of appreciation of the work of these two officers was carried by acclamation.

Presentation to Dr. J. S. Baird:

At the invitation of the President, Dr. Magnus, Dr. J. V. Hall Best, Federal President of the Australian Dental Association, took the opportunity offered by this meeting to present on behalf of the Federal body to Dr. J. S. Baird a framed illuminated address as a token of the Federal body's appreciation of Dr. Baird's services as Vice-President of the Association. Dr. Baird, in reply, expressed his appreciation of this token of recognition of his services.

Closure of Meeting:

The meeting terminated at 9.10 p.m.

General Meeting

Extract from the Minutes of the Ordinary General Meeting of the Association held in the Lecture Hall, B.M.A. House, 135-137 Macquarie Street, Sydney, on Tuesday, 27th November, 1951, at 9.15 p.m.

The Ordinary General Meeting of the Association having been convened immediately following the Annual General Meeting referred to above, Dr. E. R. Magnus was elected Chairman.

Minutes: The Minutes of the General Meetings held on 20th September, 1951, and 16th October, 1951, were read and signed as correct records.

Film programme: A series of films of general interest were shown to the Meeting.

Announcement of Election of Honorary Officers for 1951-52:

The newly-elected Executive, having attended a Special Meeting of the Executive of the Association, appeared before the Meeting and the Chairman, Dr. Magnus, announced the election of Dr. A. G. H. Lawes as President for the ensuing year.

Dr. Lawes assumed the Chair and introduced the newly-elected Vice-Presidents, Dr. F. E. Helmore and Dr. A. G. Rowell, and the newly-elected Honorary Treasurer, Dr. E. H. Bastian. He then formally introduced to the meeting the newly-elected Executive.

Dr. Lawes expressed his appreciation of the honour of his election as President and the Association's thanks and gratitude for the excellent services of the retiring officers.

Closure of Meeting:

The meeting terminated at 10.30 p.m.

Executive Meetings

Extract from the Minutes of the Special Meeting of the Executive held in the Hardwick Memorial Library, B.M.A. House, 135-137 Macquarie Street, Sydney, on Monday, 5th November, 1951, at 5.30 p.m.

Present: Dr. E. R. Magnus, President, in the Chair, and 11 members of the Executive.

Apologies: From 7 members of the Executive.

In attendance: Mr. E. F. Hewlett, Secretary.

BUSINESS OF THE MEETING:

Consideration of Balance Sheets and Auditor's Report for the year ending 30/9/51:

The Balance Sheets of the Association and of the Defence Fund for the year ending 30th September, 1951, together with the Auditors' Report, were tabled and examined by the Executive.

Mr. Black, of Messrs. Beck and Wayland, Auditors, was present upon the invitation of the President and explained matters occurring in the Balance Sheet and Auditor's Report.

Annual Report:

The draft Annual Report, both General and Financial, was tabled and examined. It was

resolved that the Annual Report, together with the Balance Sheets, be printed for circulation to members.

Membership:

New members: It was resolved that the following dental practitioners, whose applications were in order and who had paid the requisite subscriptions, be admitted to membership of this State Branch as from 5th November, 1951:—Keldoulis, James, B.D.S.; Longmore, Wilfrid Roy, B.D.S.

Resignation: It was resolved that the resignation of Mr. E. C. Edwards, of T. & G. Building, Park Street, Sydney, be accepted as from 31st December, 1951.

Deceased: It was resolved that the name of Mr. H. G. Tyndall, of High Street, Coff's Harbour, be deleted from the Register of Members.

General Business:

Annual General Meeting: Scrutineers were appointed in accordance with Article 25 (1) (f) for the forthcoming ballot for the election of the Executive, and final arrangements were made concerning the Annual General Meeting.

Closure of Meeting:

The meeting terminated at 7.40 p.m.

Extract from the Minutes of the Meeting of the Executive held in the Council Room, B.M.A. House, 135-137 Macquarie Street, Sydney, on Monday, 12th November, 1951, at 7.30 p.m.

Present: Dr. E. R. Magnus, President, in the Chair, and 19 members of the Executive.

Apologies: From three members of the Executive.

In attendance: Mr. E. F. Hewlett, Secretary.

Minutes: The Minutes of the Meetings of the Executive on 8th October, 1951, and 5th November, 1951, were signed as correct records.

BUSINESS OF THE MEETING:

Industrial:

Dental Assistants and Secretaries' (State) Award: A conference between members of the Committee to deal with the Dental Assistants and Secretaries' (State) Award and representatives from the Dental Assistants' Association of New South Wales, concerning the dental assistants' claims under a new award to be applied for in the near future, was reported upon.

The Executive considered these claims and discussed them at length.

Nurses Other than in Hospitals (State) Award: The Employers' Federation of New South Wales was instructed to act in the matter of a review of this Award on behalf of the Association.

Federal Office:

Annual General Meeting of the Association: The delegates to the Annual General Meeting of the Australian Dental Association, held on Saturday, 27th October, 1951 (viz., Dr. A. G. H. Lawes and Dr. E. R. Magnus), reported on matters dealt with at that meeting, which included the increase in capitation fees payable to the Federal body, Pharmaceutical Benefits Act, importation of dental materials, honours and awards, and repatriation dental treatment.

They also reported that the Federal Council had admitted as an affiliated body the Australian Society of Orthodontists upon certain conditions defined under Section 3 (i) (2) of the Constitution.

They further reported that the existing Federal officers, viz., Dr. J. V. Hall Best, President; Dr. K. Adamson and Dr. J. Wark, Vice-Presidents; Mr. N. E. Edney, Honorary Secretary; Dr. A. G. Rowell, Honorary Treasurer, had been re-elected for the ensuing year.

The matters of the appointment of the Standards Committee and the Association's representative on the National Health and Medical Research Council were also reported as having been dealt with.

The delegates further reported that at a Special Meeting of the Association following the Annual General Meeting the new Federal Constitution had been adopted.

Reports from Committees:

Annie Praed Oration: The Chairman of the Committee arranging this oration presented certain accounts for payment, and the Executive resolved that a donation of twenty guineas should be made to the University in appreciation of the use of the Great Hall, and that letters of thanks should be forwarded to Professor Arnott, the University authorities, and all others who assisted in the success of the function.

Survey of Fees: A preliminary report of this Committee was received by the Executive.

Finance:

Financial statement: The Honorary Treasurer, Mr. Reid, having tabled the financial statement for the month of October, 1951, it was resolved that the financial statement for the month of October, 1951, be received.

Conversion of Bonds: It was resolved that £1,000 in bonds in the General Fund be converted to long term bonds at 3¾% and that £2,000 in bonds in the Defence Fund be converted to long term bonds at 3¾%.

Divisional expenses: Expenses incurred by two Divisions during the financial year ending 30th June, 1951, were passed for payment.

General Business:

The Secretary reported that during the year 1951 visits had been made on 33 occasions by officers or clinicians to the various Divisions of the Association, and the appreciation of the Executive was conveyed to the various officers and clinicians for their services in this regard.

Closure of Meeting:

The meeting terminated at 11.45 p.m.

Extract from the Minutes of the Special Meeting of the Executive held in the Hardwick Memorial Library, B.M.A. House, 135-137 Macquarie Street, Sydney, on Tuesday, 27th November, 1951, at 7.30 p.m.

Present: Dr. E. R. Magnus, President, in the Chair, and 15 members of the Executive.

Apologies: From two members of the Executive.

In attendance: Mr. E. F. Hewlett, Secretary.

BUSINESS OF THE MEETING:

Articles of Association:

The Chairman reported that comments from the Under-Secretary for Justice on the proposed amendments to the Articles of Association had been received by the Association's solicitors and the Under-Secretary desired certain minor amendments to the suggested new articles. The Executive considered same and approved the suggested alterations.

Closure of Meeting:

The meeting terminated at 8 p.m.

Extract from the Minutes of the Special Meeting of the newly-elected Executive held in the Council Room, B.M.A. House, 135-137 Macquarie Street, Sydney, on Tuesday, 27th November, 1951.

Present: Fifteen members of the Executive.

Apology: From one member of the Executive.

In attendance: Mr. E. F. Hewlett, Secretary.

Appointment of Chairman: Mr. N. E. Edney was elected as chairman of the meeting pending the election of the office-bearers for the ensuing year.

Election of Office-Bearers:

President: It was resolved that Dr. A. G. H. Lawes be elected President for the ensuing year.

Vice-Presidents: It was resolved that Dr. F. E. Helmore be elected a Vice-President for the ensuing year.

It was further resolved that Dr. A. G. Rowell be elected a Vice-President for the ensuing year.

Honorary Treasurer: It was resolved that Dr. E. H. Bastian be elected Honorary Treasurer for the ensuing year.

The Chairman vacated the Chair in favour of the newly-elected President, Dr. A. G. H. Lawes, congratulating Dr. Lawes on his election and pledging the support and loyalty of the newly-elected Executive for the ensuing year.

Dr. Lawes, in reply, thanked the Executive for the honour they had conferred on him in electing him as President and welcomed two new members to the Executive, viz., Dr. A. G. Rowell, formerly an additional member of the Executive, and Mr. N. D. Martin, a new appointment to the Executive.

Appointment of Additional Members of the Executive on Nomination by Divisions:

The following nominations having been received from six country Divisions of the Association:—

Southern Division—Mr. G. M. Cox, Wagga.

South Coast Division—Dr. J. D. Oddy, Wollongong.

North and North West Division—Mr. A. R. J. Wooller, Armidale.

Newcastle and Hunter River District Division—Mr. C. D. Reynolds, Newcastle.

North-Eastern Division—Mr. F. C. Haddan, Taree.

Blue Mountains Division—Mr. M. J. Griffin, Penrith,

it was resolved that the above members be appointed as additional members of the Executive.

Election of Committees:

Committee of the Honorary Officers: It was resolved that Mr. N. E. Edney be added to the Honorary Officers of the Association to form the Committee of the Honorary Officers.

The following Committees were elected:—

Defence: Dr. F. E. Helmore, Chairman; Dr. E. H. Bastian, Mr. C. C. Croker, Mr. N. E. Edney and Dr. E. R. Magnus.

Journal: Mr. A. G. Hunter, Chairman; Mr. G. E. Baulman, Mr. E. J. Gee, Mr. N. D. Martin, Mr. R. Y. Norton, Mr. R. Tompson, Dr. Ellice Weir.

Dental Health: Mr. R. Tompson, Chairman; Dr. L. G. Crane, Dr. Basil Jones, Mr. N. D. Martin, Dr. R. N. McMullin, Mr. R. Y. Norton, Mr. T. Royse-Smith, Mr. J. W. Skinner, Dr. A. Thornton Taylor, Mr. G. Morse Withycombe.

Research: Mr. W. A. Grainger, Chairman; Professor A. J. Arnott, Dr. J. S. Baird, Mr. R. L. Gabriel, Dr. R. M. Kirkpatrick.

Membership:

New member: It was resolved that the following dental practitioner, whose application was in order and who had paid the requisite subscription, be admitted to membership of this State Branch as from 27th November, 1951:—McCook, John Hill, B.D.S.

Closure of Meeting:

The meeting terminated at 10.15 p.m.

Extract from the Minutes of the Ordinary Monthly Meeting of the Executive held in the Council Room, B.M.A. House, 135-137 Macquarie Street, Sydney, on Monday, 10th December, 1951, at 7.30 p.m.

Present: Dr. A. G. H. Lawes, President, in the Chair, and 17 members of the Executive.

Apology: From one member of the Executive.

In attendance: Mr. E. F. Hewlett, Secretary.

Minutes: The Minutes of the Ordinary Meeting of the Executive on 12th November, 1951, and of the Special Meetings of the Executive on 27th November, 1951, were signed as correct records.

BUSINESS ARISING FROM THE MINUTES:

Articles of Association:

The Chairman indicated to the Meeting that the Under-Secretary for Justice had formally approved the suggested amendments to the Articles of Association and had undertaken, upon receipt of a copy of the necessary special resolutions, to obtain the approval of the Governor and the Executive Council. Accordingly, an Extraordinary General Meeting of the Association had been convened for Thursday, 20th December, 1951, due notice as required by the Companies Act having been given and the proposed resolutions set out in particular in the notice convening the meeting.

Emergency Dental Treatment — Holiday Period:

The Chairman stated that arrangements for a roster for emergency dental treatment over the Christmas-New Year holiday period were well in hand.

Dental Assistants and Secretaries' (State) Award:

It was resolved that the Association engage the services of Mr. Sassall of the Employers' Federation to appear in the matter of the claims by the Dental Assistants' Association in relation to a new Award.

BUSINESS OF THE MEETING:

Appointment of Additional Members of the Executive:

Nominations were received from the following two Divisions of members as additional members of the Executive:—

Southern Tablelands Division — Mr. L. Cooper, Queanbeyan.

Western Division — Mr. L. B. Hume, Molong.

It was resolved that these members be appointed as additional members of the Executive.

Election of Committees:

Following upon consideration and decisions in regard to chairmanship and the attendance of Honorary Officers at Committee meetings, the following committees were elected:—

Membership: Dr. F. E. Helmore, Chairman; Mr. H. McD. Finnie, Mr. R. Y. Norton.

Syllabus: Mr. W. A. Grainger, Chairman; Mr. E. J. Gee, Mr. N. D. Martin, Mr. J. W. Skinner.

Divisions: Mr. R. Krauss, Chairman; Mr. N. E. Edney, Mr. H. McD. Finnie, Mr. R. Goodwin Leeder, Dr. J. D. Oddy.

Sports and Social: Mr. R. Y. Norton, Chairman; Mr. K. O. Binns, Mr. J. G. Fletcher, Mr. R. Goodwin Leeder, Mr. L. J. Noone, Mr. F. R. Reid, Mr. T. Royse-Smith, Mr. R. W. Wilson.

Benevolent and Provident Fund: Dr. E. H. Bastian, Chairman; Mr. R. C. Dennett, Mr. R. Krauss, Mr. L. J. Noone, Dr. J. D. Oddy, Mr. F. R. Reid.

Library: Mr. A. G. Hunter, Chairman; Dr. R. W. Halliday, Mr. N. D. Martin, Mr. R. Tompson, Mr. A. O. Watson.

Post-Graduate Courses: Mr. W. A. Grainger, Chairman; Dr. G. V. Gengos, Dr. R. W. Halliday, Dr. F. E. Helmore, Mr. R. Krauss, Mr. N. D. Martin, Dr. R. N. McMullin.

Articles of Association: Dr. A. G. Rowell, Chairman; Mr. J. G. Fletcher, Mr. E. J. Gee, Mr. R. Krauss, Mr. R. Y. Norton.

Economics: Dr. E. H. Bastian, Chairman; Dr. L. E. McDermott, Dr. J. D. Oddy, Mr. T. Royse-Smith, Mr. John Spencer.

Apprenticeship in Dental Technology: Mr. R. Krauss, Chairman; Mr. N. E. Edney, Dr. C. H. Graham.

Dental Assistants and Secretaries' (State) Award: Mr. N. E. Edney, Chairman; Mr. J. G. Fletcher, Mr. E. F. Hewlett.

The Illegal Practice Investigation Committee was also appointed.

Upon the resignation of Dr. Helmore as Chairman of the Defence Committee, Dr. E. R. Magnus was appointed Chairman of that Committee.

Standards Liaison Officer: Mr. A. G. Hunter was appointed to continue in this position.

Membership:

New Members: It was resolved that the following dental practitioners, whose applica-

tions were in order and who had paid the requisite subscriptions, be admitted to full membership of this State Branch as from 1st January, 1952:—Hayes, Kevin Vincent, B.D.S.; Procter, Darrell William Albert, B.D.S.

Restricted: It was resolved that Mr. Stanley Johnston Dean, of Lindfield, be granted restricted membership of this State Branch as from 1st January, 1952.

Resignations: The resignations of the following members were accepted as from 1st January, 1952:—Benson, J. D.; Cohen, P. B.; Crook, F.; Latimer, Lorna J.; Lambert, J. P.; Patten, R. J.; Wood, W. P.

Deceased: It was noted with regret that Mr. R. M. Smith of Burwood had died recently.

Delegation of Executive's powers re membership to Honorary Officers: It was resolved that the Committee of the Honorary Officers be appointed as a Committee from the Executive to deal with membership until the next meeting of the Executive.

Financial Statement:

The Honorary Treasurer, Dr. Bastian, tabled the financial statement for the month of November, 1951, which had been circulated to members of the Executive, and it was resolved that this financial statement be received.

Closure of Meeting:

The meeting terminated at 11.55 p.m.

South Coast Division

The Annual Meeting of this Division was held on 7th November, 1951, at 8 p.m., when the following officers were elected for the year 1952:—

Chairman: Mr. R. G. Esdaile.

Vice-Chairman: Mr. Ashton Marshall.

Hon. Secretary: Mr. J. H. Palmer.

Asst. Secretary: Dr. J. D. Oddy.

Hon. Treasurer: Mr. G. Meldrum.

Nominee as additional member of the Executive: Dr. J. D. Oddy.

Chairman, Dental Health Committee: Dr. J. D. Oddy.

Blue Mountains Division

At the Annual Meeting of the Blue Mountains Division held on 10th November, 1951, the following officers were elected for the year 1952:—

Chairman: Barry Stern.

Vice-Chairman: E. P. Bateman, D. W. McEwan.

Hon. Secretary: W. R. Buchanan.

Hon. Treasurer: Harold Benbow.

Committee: K. S. Hutchinson, R. R. Mathews, H. Weingarth.

Nominee as additional member of the Executive: M. J. Griffin.

Southern Tablelands Division

At the Annual Meeting of this Division held in Goulburn on 24th November, 1951, the following officers were elected for the year 1951-52:—

Chairman: Mr. D. J. Denney.

Hon. Secretary & Treasurer: Mr. K. R. Fisher.

Committee: Mr. M. Hamilton, Mr. L. Marshall.

Nominee as additional member of the Executive: Mr. L. Cooper.

Western Division

At the Annual Meeting of this Division held on Saturday, 8th December, 1951, the following officers were elected for the year 1951-52:

Chairman: Dr. G. Dent.

Hon. Secretary: Mr. J. Meldrum.

Hon. Treasurer: Mr. A. Dalziell.

Committee: Mr. L. Hume, Mr. H. D. Burrows.

Nominee as additional member of the Executive: Mr. L. B. Hume.

Information from the Dental Board

Extract from the Minutes of the Regular Meeting of the Dental Board of New South Wales held in the Board Room, 52 Bridge Street, Sydney, on Wednesday, 24th October, 1951, at 4 p.m.

Present: Dr. J. S. Baird, President; Professor A. J. Arnott, Mr. G. Cameron, Mr. N. E. Edney, Dr. E. R. Magnus, Dr. A. G. H. Lawes, Dr. H. Wallace.

Apology: Mr. E. Cahalan.

Minutes: The Minutes of the Ordinary Meeting held 26th September, 1951, were confirmed as read at the meeting.

Applications for Registration:

Registration was granted to the undermentioned under Section 10 (1) (a) of the Act, together with the approval to use the description shown:—Frederick Siegfried Altmann, B.D.Sc., University of Queensland, 1950.

Additional Descriptions under Section 6 (1) (e):

The Board approved an entry in the Register in the following case and resolved that a letter of congratulation be sent to the applicant:—Susan Mary Hull, M.D.S., Sydney University, 1951.

Foreign Applications for Registration—Further Consideration:

It was resolved that the application of A. F. Baranoff (West China University) be referred to the Sub-Committee on Foreign Dentists for examination and report to the Board.

Correspondence:

Supreme Court Judgment—Diehl vs. Dental Board: Copies of the judgment having been previously distributed, the President congratulated Professor Arnott, Mr. Cameron and the Registrar on their able assistance to the Board.

C. Kudrynski—Regulation 28 Examination: The Registrar undertook to advise Mr. Kudrynski suitably.

Sydney University—Proficiency Prizes for 1st and 2nd Year Dental Students:

Mr. Edney gave notice of his intention to move the following motion at the next Board meeting:—

"That £100 be appropriated from the Dental Board Education and Research Account for the purpose of providing general proficiency prizes for First & Second Year students in the Faculty of Dentistry at the University for 1951."

Closure of Meeting:

The meeting terminated at 5.35 p.m.

Extract from the Minutes of the Special and Ordinary Meetings of the Dental Board of New South Wales held in the Board Room, 52 Bridge Street, Sydney, on Wednesday, 28th November, 1951, at 3.55 p.m. and 4 p.m. respectively.

Present: Dr. J. S. Baird, President; Professor A. J. Arnott, Mr. E. Cahalan, Mr. N. E. Edney, Dr. A. G. H. Lawes, Dr. E. R. Magnus, Dr. H. Wallace.

Apology: Mr. G. Cameron.

SPECIAL MEETING:

In the absence of a quorum at 3.55 p.m. the meeting was adjourned *pro tempore* on a motion by Professor Arnott supported by Mr. Edney.

ORDINARY MEETING:

Minutes: The Minutes of the Meeting held on 24th October, 1951, were confirmed as read at this meeting.

Adjournment: On a motion by Professor Arnott supported by Mr. Edney the Ordinary Meeting was adjourned until the conclusion of the Special Meeting.

SPECIAL MEETING:

Mr. Edney moved and Dr. Magnus seconded the following motion:—

"That £100 be appropriated from the Dental Board Education & Research Account for the purpose of providing general proficiency prizes for First and Second Year students in the Faculty of Dentistry at the University for 1951."

ORDINARY MEETING (resumed):

Examination Reports:

Laszlo Schwarcz: The results of a Regulation 28 Examination were tabled. It was resolved that the results be received.

Applications for Registration:

The following applicants appeared in person in connection with their applications for registration which, being in order, were granted under Sections 10 (1) (a) and 10 (1) (c) of the Act, together with approval to use the descriptions shown:—

Taubman, Judith Ray—Section 10 (1) (a)—B.D.S., Sydney University, 1951.

Chappell, Brian Wilfred—Section 10 (1) (a)—B.D.S., Sydney University, 1950.

Schwarcz, Laszlo—Section 10 (1) (c).

Applications for Restoration:

Bell, Reginald Davis: It was resolved that this applicant be restored to the Register.

Wyatt, Richard Cecil Gordon: It was resolved that this applicant be restored to the Register.

Foreign Applications for Consideration:

The following applications were referred to the Sub-Committee on Foreign Dentists for consideration and report to the Board:

Bartlewski, J.—Frankfurt, Germany.

Krivanek, J.—Doctor of General Medicine, Charles IV University, Prague.

Eilerts de Haan, A.—D.D.S., Chicago; Dental Diploma, Utrecht; Master of Science (Dent.), Northwestern University.

Politis, P.—National & Capodistrian University, Athens.

Correspondence:

Auditor-General's Report for year ended 30/6/51: The report was received.

Report of Sub-Committee on Foreign Dentists: It was resolved that the application of A. F. Baranoff (West China Union University) for registration under Section 10 (1) (b) be refused.

Closure of Meeting:

The meeting terminated at 6.10 p.m.

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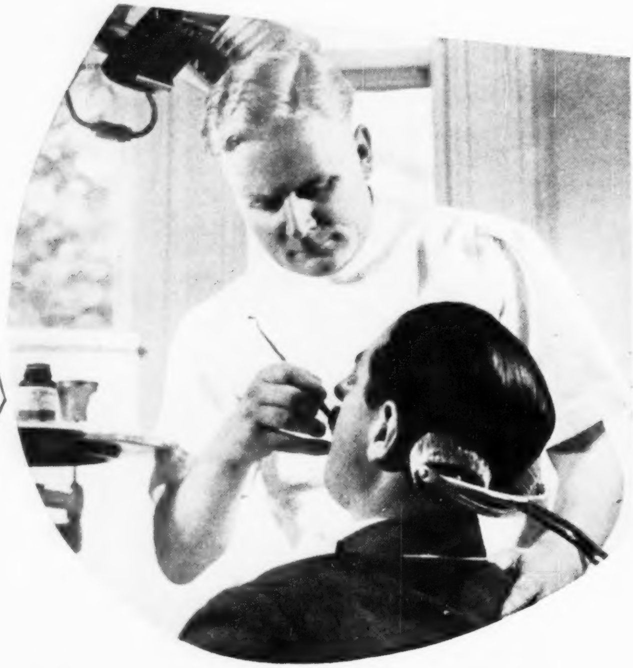

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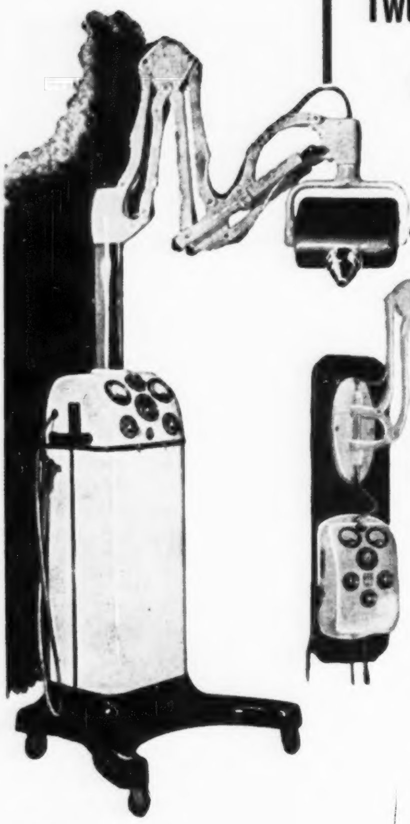

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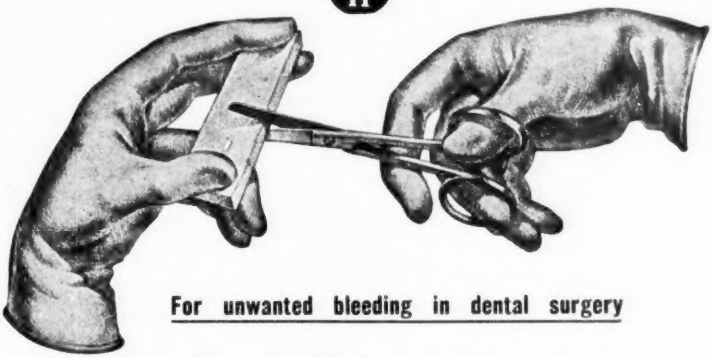

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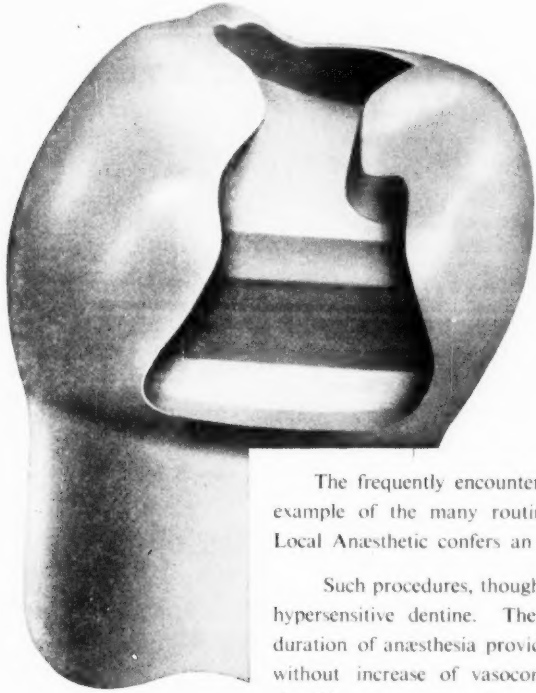

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